# Major Employers Group

32 Davey Street Hobart 7000

**Postal Address**
GPO Box 937 Hobart 7001

Telephone (03) 6223 8600
Facsimile (03) 6231 1689
Email contact@tasminerals.com.au
Website www.tasminerals.com.au

Senate Economics Legislation Committee
economics.sen@aph.gov.au

Dear Senator Hurley

***Re: Inquiry into the Renewable Energy (Electricity) Amendment Bill 2009***

The Tasmanian Major Employers Group (MEG) welcomes the opportunity to submit this paper to the Senate Economics Legislation Committee Inquiry.

The MEG is concerned about the total cost of climate policy to Tasmania's energy intensive industries. In Tasmania, five of these major businesses consume approximately 45% of Tasmania's total electricity demand.

This brief submission uses the case of Tasmania's only aluminium smelter to illustrate the externally imposed costs which will impact upon Tasmania's energy intensive industries and industry in general.

The Bell Bay aluminium smelter in northern Tasmania is owned and operated by Rio Tinto Alcan. It is a business that is both energy intensive and emissions intensive. It is also currently confronted by a raft of economic challenges, influenced by –

- Difficult and unprecedented world economic conditions
- Australian Government policies in the area of climate change, specifically CPRS and RET
- Rising energy costs in the national market
- Additional cost burdens sanctioned by the Australian Energy Regulator for high-voltage transmission within the State.

Like most commodity producers, the smelter has been hit by an unprecedented fall in the price of aluminium influenced by a fall in demand and an oversupply in the global market and a fluctuating Australian dollar. The price Rio Tinto Alcan receives for the products it produces at the Bell Bay smelter is determined by the London Metals Exchange, and therefore as a price taker, the smelter is unable topass on additional costs to its customers.

From the outset, we should underscore the fundamental importance of heavy industry to Tasmania's export-oriented economy. In 2008 The MEG commissioned Dr Bruce Felmingham and Associates to independently analyse how five selected enterprises in the State interact with the wider economy. We have attached a copy of Dr Felmingham's report for the Committee's reference. His input/output model is acknowledged by economists to be accurate in assessing economic activity at the regional scale. The five selected enterprises included some of Tasmania's largest energy consumers and comprised: –

- Norske Skog at Boyer in southern Tasmania (makers of newsprint)
- The Rio Tinto Alcan aluminium smelter at Bell Bay in northern Tasmania
- The base metals mine of OZ Minerals at Rosebery on the West Coast (now under the ownership of the MMG Group)
- The zinc smelter of Nystar in Hobart and
- The TEMCO manganese smelter at Bell Bay.

Among other things, the Felmingham report noted –

- The withdrawal of the five enterprises would reduce the output of Tasmanian industry by more than $3.6 billion annually
- Their withdrawal would reduce Tasmania's Gross State Product by $1.8 billion or twelve per cent of its real income
- Their withdrawal would lead to a fall in the annual wage income of $479 million
- The job loss would amount to 7,035 fte positions
- They are almost exclusively price takers and do not appear to possess any substantial monopoly power
- The prices they receive are volatile, unpredictable and lead to price surprises

- …these industries remain absolutely critical to the economic welfare of this island.

- ….the shutdown of the sampled enterprises would create the largest displacement of labour experienced in Tasmania since the Great Depression

- The contribution of the sample to a healthy Tasmanian economy is profound.

Members of the Senate Committee will note from Dr Felmingham's report that the Tasmanian economy is fragile, in that it is dominated by export industries which are mainly in the minerals sector.

The pursuit of carbon reduction policies by the Australian Government in response to climate change has two key planks –

- The Carbon Pollution Reduction Scheme, which at the time of writing was before the Senate and

- The mandated use of renewable energy, ratcheting from 9500 GWh by 2010 to 45000 GWh by 2020.

The Major Employers Group in Tasmania notes and agrees with the position of the Minerals Council of Australia in relation to the Carbon Pollution Reduction Scheme. While acknowledging that the RET is the key focus of the Senate Committee Inquiry, it is important to note the impact and total cost of the Australian Government's climate change policies on Tasmanian industries that are trade exposed and energy intensive. The impact on the Bell Bay aluminium smelter is particularly significant, despite it using predominantly renewable hydro electricity.

Both the Council of Australian Governments (COAG) and the Department of Climate Change (DCC) have acknowledged that trade exposed, energy intensive industries will be hit hard by changes to the RET, and proposed to link exemption assistance to an expanded RET to the same transition arrangements provided in the CPRS.

Using aluminium as an example, because it is the most significantly impacted industry, it will qualify for a 90% exemption but only for the expanded RET, but receives no exemption from the current RET target. The DCC's own data (by consultants MMA) shows that this equates to only a 55% exemption because the decision to expand the timeframe and quantity of mandated renewable energy has substantially increased the cost of meeting the current RET.

What this means for the Bell Bay aluminium smelter is that it is facing an impost of ~A$70 million for RET, representing about one third of the cost to that business of the Government's climate change policy over the decade to 2020 (when combined with CPRS).

For the reasons outlined above, the smelter cannot pass on these costs to its customers. There are only limited options for absorbing these costs and they include cutbacks in employment and capital expenditure. As highlighted in the Felmingham report, this will in turn impact the Tasmanian economy.

Consequently we ask that members of the Committee amend the Legislation to ensure that industries that are both emissions and electricity intensive receive a true 90% exemption from both the current and expanded RET.

We ask that members of the Senate Committee consider this as an important issue which can deliver a win-win outcome - sustaining employment in the resource sector and creating incentives for growth in the renewable energy sector.

Returning to the report by Dr Felmingham, it is important to remind Senate Committee members that it is possible for the unintended consequences of policy or regulatory implementation to have a devastating effect on the Tasmanian economy. We trust that Committee members will give these matters serious consideration.

Yours Faithfully

Terry Long
Chair
Major Employers Group
Tasmania.

# A Socioeconomic Analysis of Selected MEG Industries' Contribution to the Tasmanian Economy : Final Report

MAY 2008

**BY**

**B.S. FELMINGHAM CONSULTANCY**

**ABN: 44461998108**

# A Socioeconomic Analysis of Selected MEG Industries' Contribution to the Tasmanian Economy

## EXECUTIVE SUMMARY

The consultants and the Major Employees Group agreed to the following ***Terms of Reference*:**

- To analyse the ***structure of the Markets*** confronting the MEG companies with the following specific issues evident:

  - The stability of prices
  - The trends in price behaviour
  - The behaviour of the US-AUD exchange rate
  - Correlative and Causal Relationships between commodity prices and the exchange rate

- ***To measure the aggregated economic impact*** flowing from the withdrawal of 5 MEG industries. The sample of 5 being Nyrstar Hobart (formerly trading as Zinifex Hobart Smelter), Zinifex Rosebery Mine, Rio Tinto Aluminium (Bell Bay) Limited (formerly known as Comalco), TEMCO and Norske Skog. This assessment is focused on the Statewide impacts of withdrawal of production on output, value added (GSP contribution), wage incomes of Tasmanians and employment.

- ***Methodology***

  - The market study is based on a time series analysis of commodity prices
  - Correlation analysis is used to determine the links between prices and the exchange rate
  - Causality is assessed by applying some Granger causality tests
  - The stability and stationarity of individual time series is also addressed
  - Tests for a long run relationship (cointegration) are also conducted.
  - The relationship between prices, profits and employment is also explored.

- Economic impacts are assessed by applying the I/O multiplier analysis in the TIRO model to the estimated final demand for the output of the 5 companies, TEMCO, Rio Tinto Aluminium (Bell Bay), Nyrstar Hobart and Zinifex Rosebery Mine. These were all included in a single analysis using the mineral processing multipliers from the TIRO model. The Norske Skog study was conducted using Timber Processing multipliers and the Zinifex Rosebery study employed TIROs Mining Industry multipliers.

- ***Findings about Market Structure***

  - Considerable price volatility is evident in Zinc, Aluminium, Newsprint and Ferromanganese prices following the first oil price shock in 1973-74.
  - A cyclical pattern is evident in these price series when expressed in real terms.
  - A trend analysis of these four price series shows declining trends particularly in relation to newsprint and Aluminium.
  - The USD/AUD exchange rate shows a downward trend until 2002 when it climbs back to current levels.
  - There is a strong positive correlation generally, between commodity prices and the exchange rate (ER).
  - Aluminium prices are unstable while trends suggest that the price will continue to fall at $1.50 per tonne each month.
  - The Random Walk argument about the behaviour of the commodity prices and the exchange rate cannot be rejected. Random walk behaviour indicates inherent instability. In this respect zinc prices are more stable than aluminium prices.
  - In relation to causality, Zinc prices lag behind aluminium but are ahead of newsprint and ferromanganese.
  - The US/AUD exchange rate (ER) does appear to lead Aluminium and Ferromanganese prices, but the relationship between the ER and other prices is weaker.
  - The markets for all products are competitive and price taking behaviour is common leading to a preference for contracted prices.
  - The correlation between the prices, profits and revenues of the 5 companies is strong (0.94 correlation coefficient).

- The ***Economic Impacts*** are briefly summarised.

  - The withdrawal of the MEG 5 would reduce the output of Tasmanian industry by $3.638 billion annually.
  - Their withdrawal will reduce Tasmania's GSP by $1.802 billion or 12% of its real income.

- Withdrawal would lead to a fall in the annual wage income of $479.58 million.

- The job loss amounts to 7,035 fte positions.

- The MEG 5 contribute to ***social well being*** in the following ways:

  - $2.891 million pa in social capital through networking.
  - $18.232 million pa in investments in human capital.
  - $3.048 million in Training and Staff Development.
  - $1.607 million in educational support.
  - $13.577 million in knowledge workers.
  - $1.196 million in property endowments.
  - $1.500 million in heritage buildings.
  - $29.439 million in capital and operations for pollution abatement in 2004-2006.
  - By reducing reportable environmental incidents by 79% in the period 2004-2006.
  - $2.404 million pa in enhanced workplace safety.
  - $7.015 million in research during 2006.

# Socioeconomic Analysis of the Major Employers' Group (MEG) to Tasmania's Economy and Welfare

## *Chapter One*

## 1.2 Introduction

The aim in this introductory chapter is to analyse the market conditions confronting the production of aluminium, zinc, steel alloy and paper production in Tasmania. The motive is to identify the strengths and weaknesses of these manufacturing processes as a precursor to the study of the economic impact of shutting a sample of the MEG industries down. The corporations involved in this study include: Nyrstar, Zinifex Rosebery, RTA (Bell Bay), Norske Skog and TEMCO, a sample of 5 MEG industries. Particular aspects of market structure are relevant including the absence of monopoly power and the resulting price taking behaviour of the corporations involved; the cyclical nature of markets and the links between prices, profits, employment and overall Tasmanian economic activity.

The structure of this chapter is as follows: in Section 1.2 we provide brief business profiles of the 5 MEG industries (MEG 5) involved, while in section 1.3, the demand side of commodity markets is analysed. Section 1.4 analyses the supply side of markets; a time series analysis of price behaviour constitutes 1.5 and some causal relations are analysed in a closing Section 1.6.

### 1.2 Brief Business Descriptions

The following section will provide a brief description of the industries that comprise the MEG 5.

**Nyrstar Hobart**

Production of Zinc at Risdon Cove in Tasmania commenced in 1917 under the ownership of the Electrolytic Zinc (EZ) Company. In 1984 it became part of the North Broken Hill group, as Pasminco in 1988 formed out of the Zinc-Lead-Silver mining and refining interests of North Broken Hill Peko Ltd and CRA Ltd. In 2001 Pasminco went into administration, from which emerged Zinifex to manage the smelter at Risdon Cove, mines at Rosebery in Tasmania, the Century mine in Queensland the Port Pirie Smelter in South Australia and smelters in the United States and the Netherlands. As of 31 August 2007, a new company, Nyrstar, took ownership of the zinc and lead smelting and alloying assets of Umicore and Zinifex, thereby formally launching the Nyrstar company and creating the worlds largest zinc producer.

Incorporated in Belgium and headquartered in London, Nyrstar has wholly owned operations in Australia, Belgium, France, the Netherlands and the USA and joint ventures in Australia, China and France as well as a 24.9% interest in Padaeng Industry Public Company Limited in Thailand. Nyrstar's shareholders, Umicore and Zinifex, have contributed approximately 40% and 60%, respectively, of the relative value of Nyrstar's assets. However, on 31 August 2007, Nyrstar was structured on an equal ownership basis with an appropriate equalisation payment to be made to Zinifex from debt raised by Nyrstar. Therefore, the business formerly known as Zinifex Hobart Smelter will be discussed in this paper under its new name – Nyrstar Hobart.

The Risdon business is integrated with the Port Pirie smelter, with the latter processing Hobart's paragoethite by-product as well as other leach product residues from historic stockpiles located on site. The Risdon business has increased its proportion of concentrate from the Zinifex Century Mine in Queensland which in turn enables Nyrstar to reduce the amount of paragoethite by-product. Currently, Risdon utilises 30% of concentrate from Rosebery with the remainder coming from the Century mine.

Nyrstar Hobart currently has production capacity to produce 255,000 tonnes of zinc metal annually, with debottlenecking plans to increase capacity to 260,000 tonnes a year. The plant also produces 420,000 tonnes per year of sulphuric acid and 28,000 tonnes of lead sulphate leach concentrate. Nyrstar provides employment for approximately 510 permanent employees and 100 contractors, generating almost $70 million in wages.

**Rio Tinto at Bell Bay**[1]

Rio Tinto's Bell Bay smelter is located on the Tamar River near George Town in Northern Tasmania. It was the first aluminium smelter built in the Southern Hemisphere, commencing production in 1955 as a joint venture between the Commonwealth and Tasmanian Governments, primarily to overcome difficulties in importing this essential metal during wartime. Bell Bay was chosen as the location because of the availability of hydro electric power and deep water facilities.

In 1960 production was about 12,000 tonnes per year. Since that time, significant investment in new technology and plant expansions have increased productive capacity to its current capacity of more than 174,000 tonnes a year. The Bell Bay smelter directly employs around 544 men and women, making it one of Tasmania's largest employers, with typically a further 100 contractors undertaking work at the site at any one time.

Rio Tinto Aluminium operates aluminium, alumina and bauxite facilities around Australasia and is part of the Rio Tinto Group, one of the world's largest diversified resources companies. In 2007, the name of the Bell Bay operation was changed to Rio

[1] http://www.comalco.com

Tinto Aluminium (Bell Bay). It had a long trading period under the Comalco banner, although Comalco was owned by Rio Tinto. In this study the site will be referred to as RTA (Bell Bay) or simply Bell Bay.

### Norske Skog at Boyer

The Boyer Paper Mill, near New Norfolk on the Derwent River, commenced production of Newsprint in 1941. Norske Skog Australian operations commenced in 2000 when it acquired Fletcher Challenge Paper, which included two Australian newsprint mills at Albury, NSW, and Boyer in Tasmania. Norske Skog is a world leading producer of newsprint and magazine paper, with 24 wholly and partly owned mills in 15 countries worldwide.

The mill uses plantation radiata pine, regrowth eucalypt and recycled fibre, which is produced at Norske Skog Albury. Annual production is around 290,000 tonnes of newsprint and related grades. This represents about 40 percent of Australian consumption.

Norske Skog manages 24,500 hectares of mostly radiata pine plantation in Tasmania, most of which is owned by the company, on freehold land or State Forest. The main focus of forest management is to provide wood to meet Boyer's needs, however other products, such as sawlogs, export chip and veneer are produced.

### TEMCO at Bell Bay

TEMCO's manganese alloy smelter is located at Bell Bay near George Town in Northern Tasmania. It commenced operation in 1962. TEMCO's facility produces both Ferro-Manganese (FeMn) and SilicoManganese (SiMn) with four furnaces that can produce either product. The facility has the capacity to produce 130,000 tonnes of FeMn and 120,000 tonnes SiMn annually.

TEMCO is part of the BHP Billiton Group, the world's largest diversified resource producer, in particular it is part of the BHP Billiton carbon steel group which also produces coking coal and iron ore. The group also has significant manganese interests in South Africa for both mining manganese and smelting alloys.

## 1.3 The Demand Side of Markets

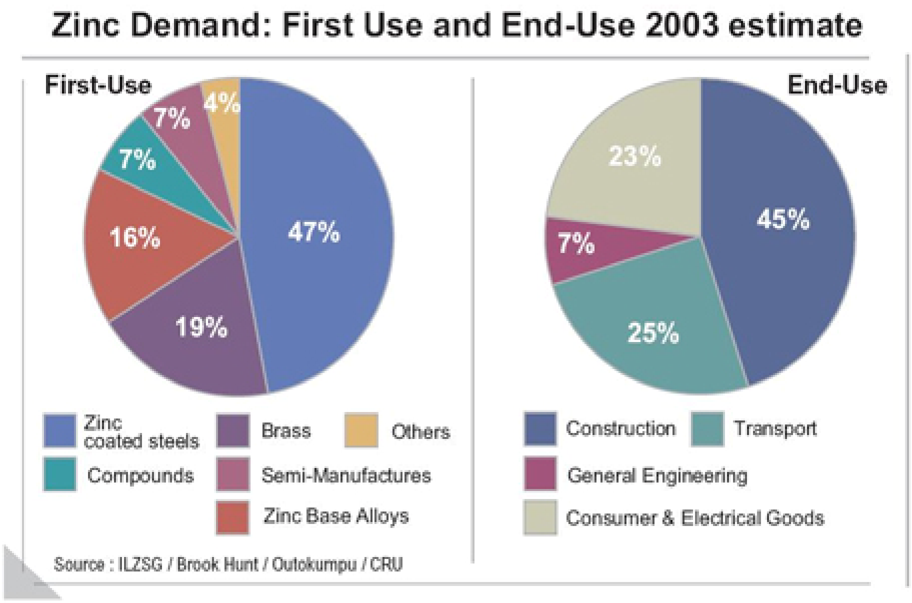
The following section provides an outline of the uses for the outputs of the MEG industries which explains the linkages between the demand for their products and the macroeconomy.

### *Zinc Uses and Demand*

Zinc has several major properties determining its use in the economy. First, there is its historic use with copper as an alloy in the production of brass. Brass generally comprises between 10% to 40% zinc and is used for household fixtures, ornamentation and architectural features, due to its combination of beauty, cleanliness and resistance to corrosion. Secondly there is the use in galvanisation and similar processes to improve the corrosion resistance of steel and other ferrous metals. Thirdly there is the use in energy storage as part of zinc-metal batteries. Final demand is in the construction, transportation, consumer goods and general engineering industries.

**Table: 1.1 Zinc Demand**

*Source: www.zinc.org*




As can be seen in the Table 1.1 above, final demand for zinc is heavily dependent on the construction sector. One would therefore expect a pro-cyclical relationship between zinc prices and global economic growth.

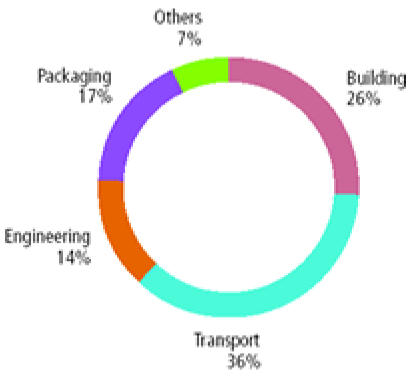
***Aluminium Uses and Demand***

Aluminium is utilised on the basis of its high resistance to corrosion (as aluminium metal reacts rapidly with oxygen to produce a protective aluminium oxide layer) and a reliable strength to weight ratio. It is also malleable, highly reflective and a good conductor. The strength to weight ratio attribute explains its use in transportation, particularly aeroplanes and rockets, but increasingly for automotive manufacture. In most applications, aluminium alloys are used because of their improved strength. Other important uses include packaging (foil and cans), and construction fittings.

**Table: 1.2 Aluminium Demand**

*Source: www.aluminium.org*

**Main End-Use Markets for Aluminium Products in Western Europe (2004)**




While demand for packaging is likely to be fairly stable over time, the demand for construction and transportation will follow cycles in the demand for these industry outputs.

***Newsprint Uses and Demand***

Newsprint is used primarily for the production of newspapers, although there are increasing uses for other forms of direct advertising. Newspaper demand varies between economies, with cultural, technology and economic factors being important explanations of these differences. North American and European markets for newspapers have been static for several decades while Asia's economic growth has seen growth in the demand for newspaper and therefore newsprint from these new markets.

Newspapers are generally reliant on advertising revenues as opposed to the newspaper cover price, so the capacity of newspapers to pay for newsprint is dependent on the demand for advertising, particularly in the housing and employment sectors. The growth of the internet has resulted in structural changes in the newspaper advertising sector, as has the growth of 'free' newspapers for community and commuters.

***Manganese Alloy Uses and Demand***[2]

Demand for manganese alloys depends directly on the production of steel. There are numerous grades of steel and each requires a different amount of manganese. Most of the manganese addition is made in the steel melting shop, the majority in the form of manganese ferro-alloys, although in some cases it can be added in the form of ore. The average unit consumption for industrialized countries is around 7.5 kg of manganese per ton of steel. While changes in steel grade chemistry have had an effect on manganese requirements for constant unit consumption, manganese demand expands in like with the growth in steel production. Manganese requirements for other metallurgical applications or for non-metallurgical uses are not significant, so that the growth in manganese demand is effectively a direct function of steel production growth.

Standard (or high carbon) ferromanganese is a very commonly used alloy. It contains more than 76% of manganese and about 7% carbon, and can be produced either in the blast furnace or in the electric furnace. Production world-wide was about 3.4 million tons in 2000.

Another high tonnage alloy is silicomanganese. The standard grade contains 14-16% Si, 65-68% Mn, with about 2% carbon. Lower carbon levels result when the silicon content is increased. Special grades with up to 30% Si are produced for use in the manufacture of stainless steel. World production of SiMn was about 3.5 million tons in 2000.

[2] www.manganese.org

## 1.4 Supply Side

The following section provides an outline of the major inputs for the MEG industries. This may then help explain ‘supply-side’ factors that influence pricing.

### *Zinc Inputs*

The major inputs into Zinc production are the ores produced at Rosebery and Century and energy inputs. There are also significant inputs produced onsite, particularly sulphuric acid. Each metric ton of zinc production expends about -4000 kWhr/ t of electric power.

### *Aluminium Inputs*

The following are the major inputs into Aluminium production: Electricity, is the major input for the smelting of aluminium, so much so that aluminium is sometimes described as ‘frozen energy’. Electricity costs account for approximately 1/3$^{rd}$ of the cost of producing aluminium and determine the location of production units. Alumina, which is produced from the refining of bauxite ore, is the other major input. RTA (Bell Bay) uses Alumina from two refineries in Queensland which are either partly or wholly owned by the Rio Tinto group. Both Alumina refineries in turn use Bauxite sourced from Weipa in the Gulf of Carpentaria. The Weipa Bauxite operation is also owned by the Rio Tinto Group. Caustic Soda is also a major input into the production of Alumina.

Aluminium is easy to recycle, so that while a significant amount of energy is required in its production, only 5% of that energy is required to recycle the metal into new uses.

***Newsprint Inputs***

The major inputs for the production of Newsprint are radiata pine, regrowth eucalyptus and recycled paper pulp.

***Ferro and Silico-Manganese Inputs***

The following principal inputs are required for the production of Ferro-Manganese alloys:

- **Manganese ore**, which in the case of TEMCO at Bell Bay, is delivered from Groote Eylandt in the Northern Territory and Hotazel in South Africa. Mexico, Gabon and Brazil are also major exporting countries
- **Iron ore**, which in the case of TEMCO at Bell Bay is delivered from South Australia.
- **Sinter**; which is produced on site and recycled as part of the production process
- **Electricity**, which is used to provide the heat required to achieve the extremely high temperatures at which the raw materials chemically react to combine in molten form; and
- **Coke or Coal**, is used as a reductant, and limestone as a flux.

Silico-manganese is produced from by-product slag from the production of ferro-manganese with the addition of coke, coal and dolomite (as a flux).

Both Manganese and Iron ore are globally traded (although not exchange traded), potentially exposing TEMCO to global pricing effects. Electricity markets are now integrated into the south-east Australian electricity market through Basslink, with continuous pricing via NEMMCO.

## 1.5 Price Time-Series Analysis

In this section we examine the price time-series for the outputs of the chosen MEG 5 using the following data and data sources.

*Zinc* price data is monthly from January 1957 to September 2006. Historic data (1957 to 2004) is compiled from the International Financial Statistics book (IFS) compiled from the IMF Medium term data (2002 to 2005) is drawn from the South African Minerals Bulletin, published by the South African Department of Minerals and Energy and more recent data (2006) is taken from the London Metals Exchange (LME). *Aluminium* price data is drawn from identical sources.

*Newsprint* price data is available monthly from January 1986 to February 2004. This newsprint series is compiled from Statistics Canada Newsprint price index (Table 329-0039: Industry price indexes, by major commodity aggregations and stage of processing; Canada; Newsprint and other paper stock, second stage (index, 1997 = 100). Note that the Canadian price index is then converted to US dollars using the IFS exchange rates for the Canadian and US dollars against the Australian data. *Newsprint* data is supplemented by client provided Annual Newsprint price data for the United States West Coast from 1960 to 2006 sourced from RISI.

*Ferro-Manganese* price data is also available monthly from January 1972 to December 2005. It is compiled from client provided monthly ferro-alloy data which in turn is sourced from CRU Bulk Ferro Alloys Monitor.

The *Australian Dollar US Dollar* exchange rate data is available monthly from January 1957 to September 2006. Historic data (1957 to 2004) is compiled from the IMF International Financial Statistics (IFS) publication. Recent data is available on www.oanda.com.

*US CPI* data is published monthly from January 1957 to September 2006. It is compiled from the United States Bureau of Labor Statistics, Consumer Price Index, All Urban Consumers U.S. City Average (CPI-U).

We first examine each price time-series visually to identify trends and relationships that may later be subject to econometric analysis and confirmation.

## Table 1.3 Nominal Price Series

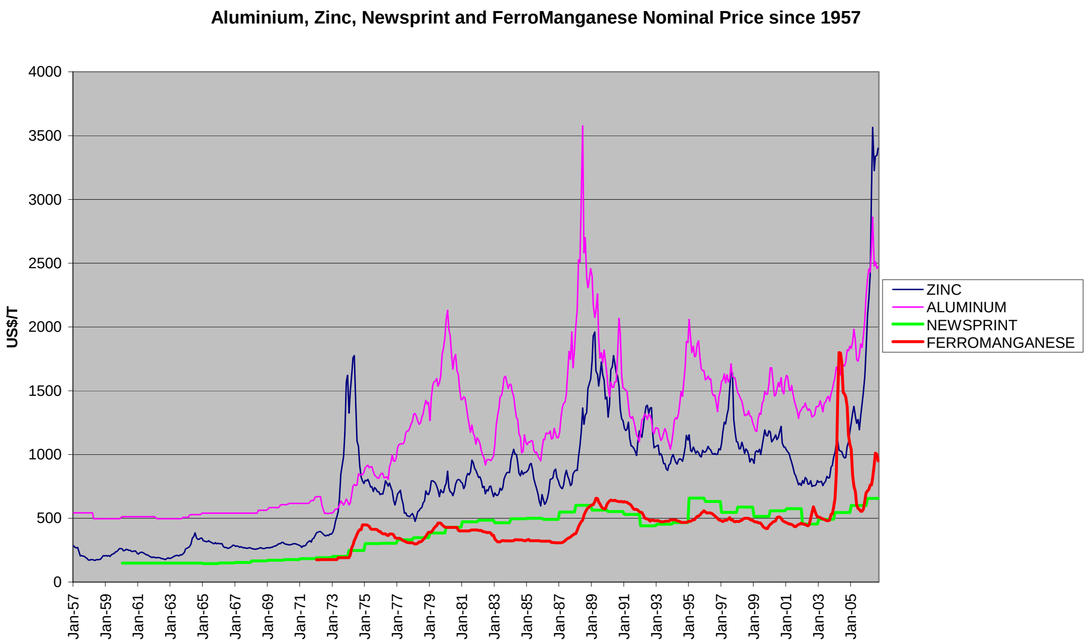
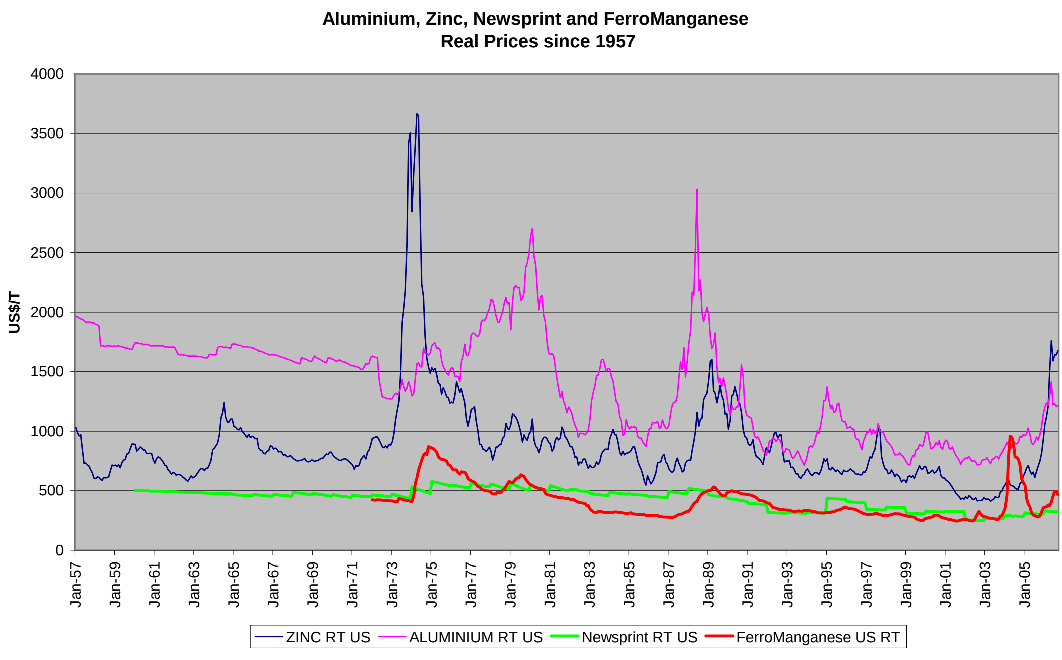



Table 1.3 above shows the price series for Aluminium, Zinc, Newsprint and FerroManganese for the period 1957 to 2006 in current prices. The time-series for Newsprint and Ferromanganese are somewhat shorter, and in newsprint the data is annual. Considerable volatility is evident in the time series, particularly from 1973 onwards. Aluminium prices start at a level approximately double that of zinc, whereas based on recent prices from the LME, the price of Zinc now exceeds that of Aluminium. This has happened occasionally in the past. Upward price volatility appears to be correlated between the series. A fact confirmed presently.

Zinc price movements appear to follow a pattern, in which case periods of price spikes are followed by declines in prices. Four spikes are evident on Table 1.3, 1973-74, 1988, 1998 and 2005-06, with a smaller price increase in 1964. Aluminium appears to have more price spikes in the post 1979 period than zinc, although price build-ups appear steady, particularly in the period 1973 to 1979. Newsprint appears to have similar cyclical peaks although with shorter troughs than zinc prices. Overall volatility, measured as the proportion of peak to trough movement in prices appears to be lower than both Aluminium and Zinc. Most of the ferro-manganese price series indicates relative stability, punctuated by relatively steep price increases, some of which are offset by sharp troughs. The most recent period indicates high potential volatility between peaks and troughs. The price appears to be far more stable (nominally fixed with major adjustments), indicating that price formation is different from that of the continuously traded zinc and aluminium commodities.

## Table 1.4 Real Price Series



When these individual price series are converted into real prices utilising the US CPI index several interesting features emerge and allow the magnitude of current and historic price spikes to be seen in context.

First for zinc, the largest price spike was associated with the 1973-74 oil price shock and while the current price rise is (just) the second largest spike, it is currently of a similar magnitude to 1989, and less than half that of 1973-74. Secondly for zinc, there appears to have been a price floor of around $550 to $600 $/tonne for most of the last 5 decades. The only period when this floor was breached was during the 2002 to 2003 trough when Pasminco experienced financial difficulties as a consequence. The relatively extended nature of that price trough suggests that most producers have cut their cloth in order to operate at these price levels, an argument which is also supported by the fact that the industry operated very close to the $550 to $600 real floor for much of the 1990s. The shape of the Zinc real price curve is consistent with a commodity market where significant entry only occurs during high price spikes. Following the occurrence of price spikes, real prices decline steadily until reaching the price floor, and are followed shortly afterwards (2-4 years) by a new price peak. The price cycle, peak to peak is very long, perhaps 15 to 17 years. The periodicity of cycles may be getting longer.

For Aluminium, there appear to be several phases in each price series. In the initial phase, pre 1973, prices are quite stable, indicating that at that time there was a degree of price stability in world markets generally. There are two major spikes in aluminium prices, occurring in 1980 and 1988, although these spikes are not quite as large as those which occurred for zinc in 1973-74. There are more minor spikes for aluminium, and the real price at the bottom of the trough has fallen steadily over time, indicating that for the majority of the period there has been no price floor. It may be argued that a price floor occurred during the 1990's at around US$ 715 tonne.

The real Newsprint price series appears to be very closely aligned with that of the Aluminium price series, almost to the point of being generated by a moving average process of the Aluminium series. The Newsprint series lacks the extreme volatility of aluminium (no 1988 spike) which may emanate from the fact that newsprint prices are often negotiated and phased in rather than being determined directly in a spot market.

The real price series for Ferro-Manganese shows clearly that the real price cycles for FeMn are similar to that for Zinc, but normally with lower peaks. Scaling indicates that the recent price spike for ferro-manganese was of a similar magnitude to that for zinc, although preceding it by almost 2 years.

## Table 1.5 Real Price Series with Trends

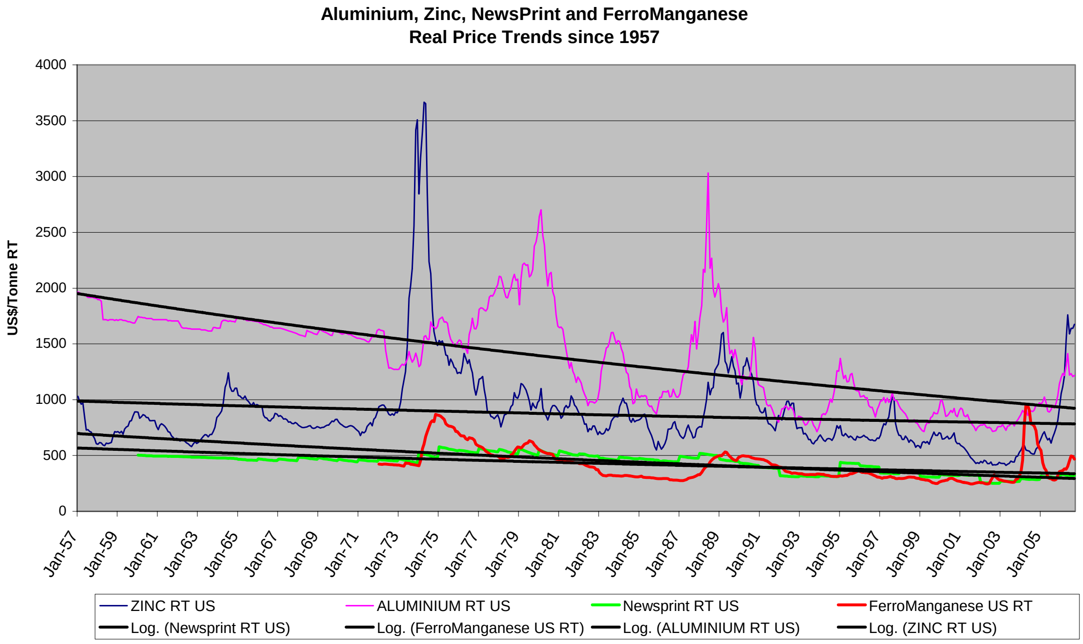



Table 1.5 above shows the trends in the prices for Aluminium, Zinc and Newsprint over the 5 decades since 1957. It demonstrates graphically that the real price of both Newsprint and Aluminium have been in steep decline (at approximately the same rate), and while the real prices of Zinc and Ferromanganese have been declining on

average, these are at significantly lower rates of decline. In trend terms, the price of Zinc and Aluminium are now at the same level, whereas at the beginning of the series, the price of Aluminium was double that of Zinc. In approximate terms, the trend price of Zinc has fallen by a quarter over the five decades, while that for Aluminium and Newsprint has more than halved.

Possible reasons for the difference in the decline of Aluminium and Zinc real prices is advances in aluminium technology occurring in the sample period implying the continuous accumulation of cost-improving technology and the relative abundance of the underlying resource for Aluminium production, namely, bauxite, which enables continuous increases in the scale of production to occur without reaching resource constraints.

**Australian Dollar Exchange Rate**
**Table 1.6 Nominal US-Australian Dollar Exchange Rate 1957 to 2006**

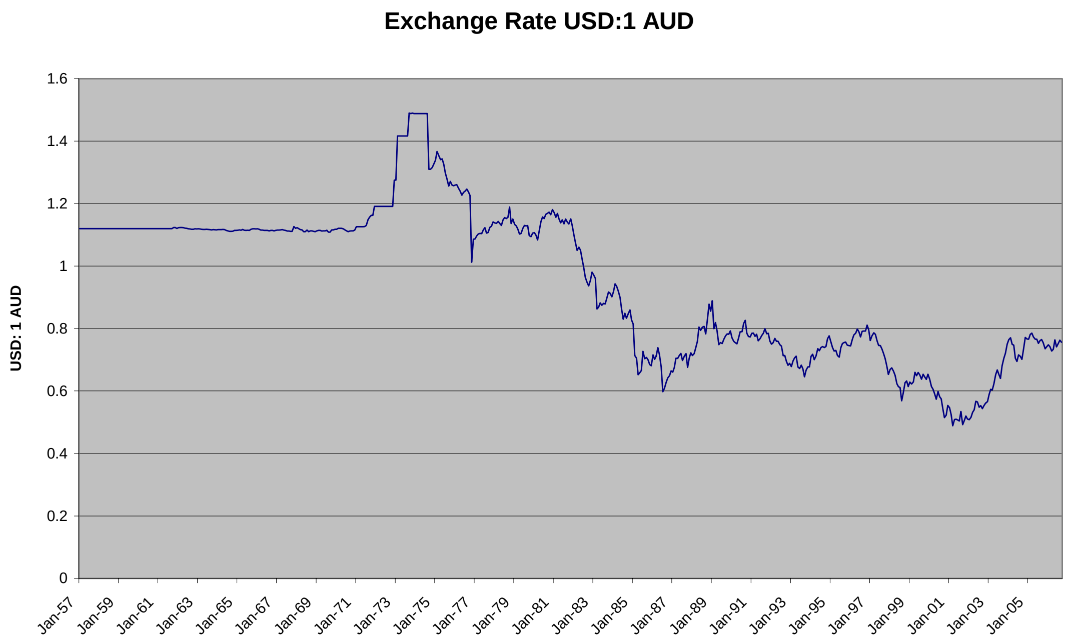



Table 1.6 above shows the monthly Australian dollar exchange rate against the US dollar over the period 1957 to 2006. The exchange rate has operated over several regimes during this period, including fixed, adjusting peg, managed float and now free-

floating. It is only during the free-floating period post 1985 that we can expect relationships between the exchange rate and commodity price to hold useful information.

## 1.6 Statistical Analysis of Causation and Correlation

### Descriptive Statistics

The following analysis of the statistical properties of the 5 relevant prices provides insights into the behaviour of these. Included here is the mean value of each price series across the time period January 1957 to January 2005; the intercept is the average value of the relevant prices series at time 0; the standard deviation is a measure of dispersion which is used later in the discussion of price volatility. The median (or mid point) is sometimes preferred as a measure of central value by statisticians to the mean (average) value because it removes the effects of outlying values. The trend price movement is most important showing the long term movement in prices because the trend component is separated from the cyclical component of each series. Table 1.7 also includes correlation coefficients between the individual series: for example, the correlation of Aluminium and Zinc prices is 0.28, between Newsprint and Aluminium prices is 0.79. This is a strong positive correlation (perfect correlation being 1 in value and no correlation 0).

## Table 1.7 Descriptive Statistics

| | Zinc | Aluminium | Newsprint | FeMn | AUD:USD |
|---|---|---|---|---|---|
| *Mean* | 875.04 | 1,383.76 | 433.05 | 412.49 | 0.946 |
| *Intercept* | 995.38 | 1,905.37 | 548.56 | 524.99 | 1.285 |
| *Trend* | - 0.40 | - 1.74 | - 0.39 | - 0.38 | - 0.001 |
| *Std Dev* | 398.46 | 420.59 | 83.58 | 146.32 | 0.240 |
| *Percentile 99$^{th}$* | 2,873.7 | 2,416.6 | 564.0 | 862.3 | 1.488 |
| *Median* | 782.4 | 1,459.3 | 459.9 | 355.8 | 1.086 |
| *Percentile 1$^{st}$* | 427.1 | 723.3 | 252.8 | 249.6 | 0.509 |
| *Corr Zinc* | 1.00 | | | | |
| *Corr Aluminium* | 0.28 | 1.00 | | | |
| *Corr Newsprint* | 0.36 | 0.79 | 1.00 | | |
| *Corr FeMn* | 0.48 | 0.54 | 0.49 | 1.00 | |
| *Corr USD:AUD* | 0.51 | 0.71 | 0.75 | 0.66 | 1.00 |

The descriptive statistics for each of the 5 individual series in Table 1.7 confirm the trends identified by inspection. Casual inspection of Table 1.7 shows that the exchange rate between the Australian Dollar and the US Dollar is relatively strongly correlated with the commodity prices. The correlation between Zinc and Aluminium is initially weak at 0.28, however if the correlation is re-estimated over a more recent period, for example 1986 to 2006 the correlation becomes much stronger (0.62).

**Time Series Analysis**

Time series analyses, such as unit root tests, seek to identify whether a time series operates around a fundamental level or moves randomly in response to the arrival of new information. We find that both the zinc and ferro-magnesium prices are 'stationary', returning to a stable underlying price following shocks such as the oil price shock in 1974. The newsprint and aluminium prices behave so that price shocks cause permanent shifts in the fair value of these commodities. We also find that both the series have statistically real price trend declines, with real Aluminium prices declining by approximately $1.50 per tonne per month on average.

Further our analysis reveals that newsprint, aluminium prices and the Australian dollar exchange rate are cointegrated. Cointegration indicates if several non stationary price series move together or separately in response to shocks, which indicates if shocks are likely to have the same origin indicating that newsprint, aluminium and the Australian dollar are likely to have been affected by the same economic shocks, such as high oil prices in 1975, or September 11 in 2001.

Granger Causality seeks to identify patterns of statistical causation between individual time-series. They tell us about the speed at which new information is incorporated into markets, with the foreign exchange and aluminium markets reacting first, based on greater numbers of potential speculators, such as hedge funds. Granger Causality may also represent the pattern of real economic influences, such as the way in which cost increases are passed through industries.

## Market Structure Assessment

Analysis of the historical price series for Zinc, Aluminium and Newsprint prices indicates that these products operate in a competitive market not subject to price control or influence by any participants. There are significant correlations between these markets suggesting they are subject to similar external economic shocks.

Aluminium and Newsprint prices display a continued downward pressure on price, while Zinc and Ferro-Manganese prices do not have statistically significant downward price trends. A price floor is evident for zinc, and may be developing for Aluminium.

Ferro-Manganese price data shows high potential movement but were not volatile on a month to month basis. This is suggestive of a more complicated oligopolistic price structure with strategic interactions between buyers and sellers. The fact that the recent price rise was only short-lived and that previous price rises have been reversed indicates that the sellers do not have price control except during periods of exceptional demand, when high prices are required as signals for investment. This is normal market behaviour. In general sellers are likely to be subject to market conditions to predict volume (volume-takers) as well as the strategic decisions of other producers.

There are significant positive correlations between commodity prices and the exchange rate USD/AUD. In general, causality appears to flow from Aluminium to the other commodities, and from the exchange rate to the other commodities. This outcome means that Australian dollar prices and income are more stable, on average, than either the US dollar denominated commodity price or the Australian dollar exchange rate.

This analyses provides significant potential benefits from a macroeconomic stability perspective, suggesting that a healthy resources sector may balance volatility associated with the tourism sector to support long-term employment and balanced growth.

**Prices, Profits and Employment Linkages**.

In Table 1.18 the correlation between earnings before interest, revenue, product prices, full time employment and people costs for the four business is analysed. As expected, there were strong positive correlations between prices, revenues and earnings for all four businesses.

## Table 1.18 Correlation of Earnings, Revenue, Employment, Prices and the Tasmanian Economy

Norske Skog

| | EBINSk | EmpNSk | PeoNSk | PriNSk | RevNSk |
|---|---|---|---|---|---|
| EBINSk | 1 | | | | |
| EmpNSk | 0.434645 | 1 | | | |
| PeoNSk | -0.31743 | 0.426475 | 1 | | |
| PriNSk | 0.643484 | 0.182513 | -0.41348 | 1 | |
| RevNSk | 0.604291 | -0.23868 | -0.17898 | 0.494331 | 1 |

TEMCO

| | EBITEM | EmpTEM | PeoTEM | PriTEM | RevTEM |
|---|---|---|---|---|---|
| EBITEM | 1 | | | | |
| EmpTEM | -0.26846 | 1 | | | |
| PeoTEM | 0.499829 | 0.507251 | 1 | | |
| PriTEM | 0.918026 | -0.37296 | 0.67562 | 1 | |
| RevTEM | 0.969558 | -0.35384 | 0.609006 | 0.957359 | 1 |

Zinifex Rosebery

| | EBIZRb | EmpZRb | PeoZRb | RevZRb |
|---|---|---|---|---|
| EBIZRb | 1 | | | |
| EmpZRb | -0.50864 | 1 | | |
| PeoZRb | -0.10107 | 0.762434 | 1 | |
| RevZRb | 0.87019 | -0.57413 | -0.15735 | 1 |

Nyrstar

| | EBIZRd | EmpZRd | PeoZRd | PriZRd | RevZRd |
|---|---|---|---|---|---|
| EBIZRd | 1 | | | | |
| EmpZRd | 0.000836 | 1 | | | |
| PeoZRd | 0.167166 | -0.64248 | 1 | | |
| PriZRd | 0.79444 | -0.32329 | 0.650943 | 1 | |
| RevZRd | 0.796404 | -0.45632 | 0.636303 | 0.904707 | 1 |

*EBI – Earnings Before Interest (A$) Emp – No of Full Time Equivalent Employees*
*Peo – People Costs (A$) Pri – Product Prices (A$) Rev – Revenue (A$)*

The relationship between employment and revenue was negative, indicating that while revenue may increase, full time employment falls as the MEG 5 contract out. However, when people costs are correlated with revenue, then there are strong positive correlations between people cost and revenue for TEMCO and Nyrstar and weak negative correlations for Norske Skog and Zinifex (Rosebery).

It is likely that increases in the efficiency of labour utilisation, through contracting out and other processes is largely independent of prices. Higher prices do, however, improve a firm's capacity to expand production. This leads to the increased utilisation of labour and higher people costs overall. Therefore while full time employment positions are reduced to ensure businesses stay competitive, higher revenues will result in greater returns to the community.

**Linkages between Revenue and the Tasmanian economy**

There are strong correlations between the revenue of the 5 MEG industries and broader measures of economic activity in Tasmania, particularly international exports. Growth in revenue and export revenue for the MEG 5 industries has outperformed the growth in Tasmania's international exports and the growth in Tasmanian GSP. Prices for these sectors are driven internationally, supporting the concept that the MEG 5 industries are one of the important 'engines of growth' of the Tasmanian economy, alongside other sectors such as tourism and housing construction.

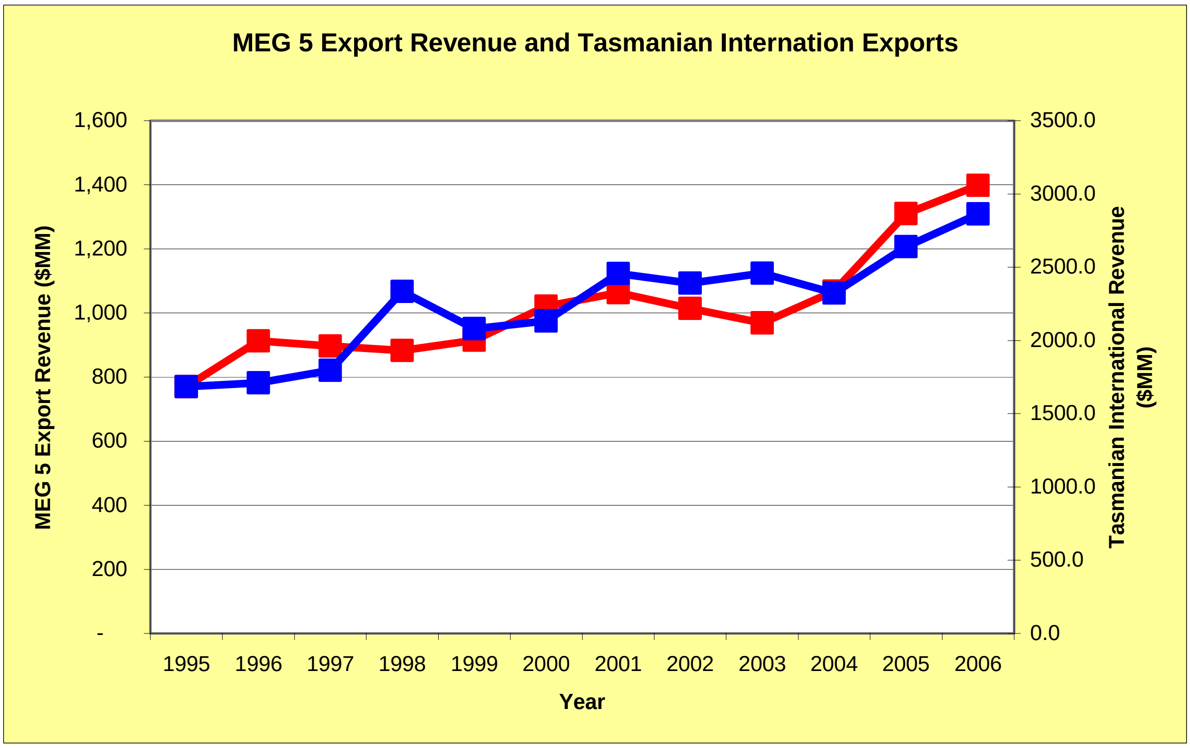



**Chart 1.1 MEG 5 Export Revenue and Tasmanian International Exports**

Chart 1.1 shows the relationship between export revenues (total revenues less those sold domestically in Tasmania) and Tasmania's international exports. Export revenues from the MEG 5 are equivalent to approximately 46% of Tasmania's international exports. The correlation between the two measures is 83.3%, with Tasmania's other exports appearing to be more volatile. Since 1995, the MEG 5 export revenues have grown by 5.5% per annum, compared to growth in Tasmania's international exports of around 5% per annum. A component of the current growth may be cyclical rather than permanent.

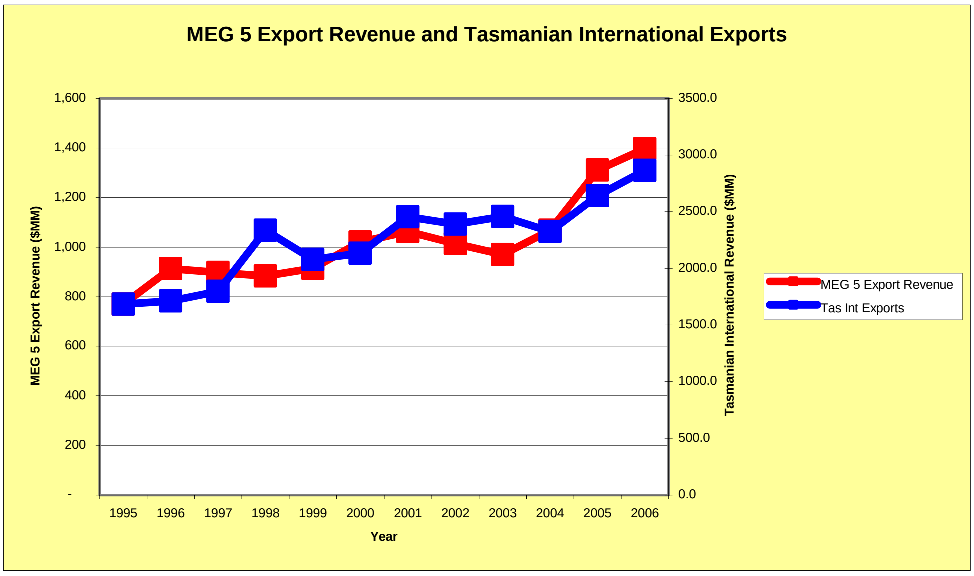



**Chart 1.2 MEG 5 Revenue and Tasmanian Gross State Product (GSP)**

Output from the 5 MEG industries represents 10% of Tasmania's Gross State Product. The relationship between the MEG 5 revenue and Tasmanian GSP can be seen in Chart 1.6. Once again the measures are well correlated (90%), but the MEG 5 revenue is more volatile. MEG 5 revenue has grown by around 6.5% per annum since 1995, while GSP has grown on average by 5.1% (both of these are nominal measures that exclude the impact of price inflation).

A major finding of this study is that price trends are driven by international forces, therefore it is logical to conclude that to the MEG industries lead outcomes for the Tasmanian economy and not the other way around. Therefore it is likely that the increases in output and revenue for the MEG 5 are one of the important contributors to Tasmania's recent economic success.

## Appendix: Time Series Modelling

### Time-Series Modelling

Time series modelling is about identifying the data generation process (DGP) behind the time-series. The DGP then allows the time-series to be forecast or for hypothesis testing.

A unit root test is a way of testing whether the process follow a random-walk, where each step in the process is assumed to be an independent random variable. Random walks are assumed for many variables, including asset prices such as shares. Disproving the existence of a unit root in the data implies that the price has a trend or other characteristics such as mean reversion which allow superior forecasting. To determine if each of our individual series has this desired mean reverting or stationarity property one can undertake an Augmented Dickey Fuller (ADF) test, the results of which can be seen in Table A1.1.

Table A1.1 Augmented Dickey Fuller Test results on time series

| Time Series | ADF Statistic | Probability |
|---|---|---|
| Aluminium | -2.337 | 16.07%. |
| Zinc | -5.148 | 0.00% |
| Newsprint | -1.405 | 57.95% |
| Ferro-Manganese | 3.133 | 2.5%. |
| Exchange Rate | -1.059 | 73.3% |

*Real Aluminium Price*

## Table A1.2 Real Aluminium as an AR(1) process

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 1845.008 | 218.3776 | 8.448706 | 0.0000 |
| T | -1.514825 | 0.586089 | -2.584635 | 0.0100 |
| AR(1) | 0.970148 | 0.010159 | 95.49332 | 0.0000 |
| R-squared | 0.970099 | Mean dependent var | | 1382.785 |
| Adjusted R-squared | 0.969998 | S.D. dependent var | | 420.2720 |

Each of the five individual prices is now treated as a dependent variable and is regressed on a time trend and a constant.

The econometric estimation is reported on Table A1.2 and shows that the Aluminium price can be effectively estimated as an auto-regressive process around a time trend and a constant. The trend component indicates an expectation that the price of Aluminium will fall by approximately $1.50 per tonne per month. The auto-regressive component implies that 97% of the forecast error (movement away from the trend) in one period is repeated in the next period. An Augmented Dicky-Fuller Test on the Aluminium Real Price series (see Table 1.7) is indicated a test statistic of -2.337 with a probability of 16.07%. This implies that we cannot reject the possibility that Aluminium prices follow a random walk and that the trend is spurious, although such a probability is low.

*Real Zinc Price*

## Table A1.3 Real Zinc price as an AR(1) process

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 785.2626 | 424.7657 | 1.848696 | 0.0650 |
| T | 0.411746 | 1.114692 | 0.369381 | 0.7120 |
| AR(1) | 0.980484 | 0.009001 | 108.9281 | 0.0000 |
| R-squared | 0.953835 | Mean dependent var | | 874.7798 |
| Adjusted R-squared | 0.953679 | S.D. dependent var | | 398.7437 |

The estimation results on Table A1.3 shows that while the Zinc price can be effectively estimated as an auto-regressive process the coefficient with respect to the time series is not significantly different from zero. This is quite in accordance with the casual inspection made around Table 1.5. An Augmented Dicky-Fuller Test on the Zinc Real Price series (see Table A1.2) indicated a statistic of -5.148 with a probability of 0.00%. This implies that we can reject the idea that zinc prices are non-stationary.

*Real Newsprint Price*

## Table A1.4 Real Newsprint price as an AR(1) process

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 109.9685 | 25.83917 | 4.255884 | 0.0000 |
| T | -0.130098 | 0.049292 | -2.639350 | 0.0089 |
| AR(1) | 0.977454 | 0.012535 | 77.97653 | 0.0000 |
| R-squared | 0.985172 | Mean dependent var | | 47.08083 |
| Adjusted R-squared | 0.985034 | S.D. dependent var | | 7.268591 |

The same methods are applied to real Newsprint price and the results of econometric estimation are included on Table A1.3. It shows that the Newsprint price can be effectively estimated as an auto-regressive process around a time trend and a constant. An Augmented Dicky-Fuller Test on the Newsprint Real Price series indicated a statistic of -1.405 with a probability of 57.95% (see Table A1.1). This implies that we cannot statistically reject the possibility that the News Print prices follows a random walk and that the trend is spurious. However given the observed correlation between Newsprint and other prices, the random-walk hypothesis is considered unlikely.

*Real Ferromanganese Price*

**Table A1.5 Real Ferromanganes price as an AR(1) process**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 11.5554 | 7.5492 | 1.5307 | 0.1266 |
| T | - 0.0095 | 0.0118 | - 0.7993 | 0.4246 |
| AR(1) | 0.9811 | 0.0098 | 100.6184 | 0.0000 |
| R-squared | 0.969832 | Mean dependent var | | 412.5448 |
| Adjusted R-squared | 0.969687 | S.D. dependent var | | 146.3341 |

The time series analysis for Ferro-Manganese shown on Table A1.5 indicated an autoregressive process without a discernible time trend. The null-hypothesis of a random-walk could be rejected with an Augmented Dicky-Fuller statistic of 3.133 and a probability of 2.5% (see Table A1.1).

*US Dollar to Australian Dollar Exchange Rate 1986-2006*

**Table A1.6 US Dollar to Australian Dollar Exchange Rate as an AR(1) Process**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.872843 | 0.304339 | 2.867994 | 0.0045 |
| T | -0.000320 | 0.000596 | -0.537584 | 0.5913 |
| AR(1) | 0.971097 | 0.015641 | 62.08482 | 0.0000 |
| R-squared | 0.947450 | Mean dependent var | | 0.700930 |
| Adjusted R-squared | 0.947025 | S.D. dependent var | | 0.085012 |

The Australian dollar exchange rate was estimated over the period of floating from 1986 onwards (coinciding with the Newsprint price series). Over this time series, there is no trend that is statistically significant, although the process is auto-regressive. An Augmented Dicky-Fuller Test on the exchange rate series indicated a statistic of -1.059 with a probability of 73.3% (see Table A1.6). This implies that we cannot statistically reject the possibility that the exchange rate follows a random walk. This is a standard economic result.

### Co-integration

A co-integration analysis was undertaken on the relationship between the Aluminium price series and the Newsprint price series. Co-integration is when a linear combination of non-stationary series results in a stationary series, implying that there is a stable economic relationship between the variables, rather than each series being determined as an independent random-walk.

## Table A1.6 Cointegration of Aluminium, Newsprint and Exchange rate

| Combination | ADF Statistic | P value |
|---|---|---|
| Aluminium - Newsprint | -3.216 | 2.04% |
| Aluminium - USDto1AUD | -2.639 | 8.65% |

Aluminium, Newsprint and the exchange rate have statistically significant forecast correlations. The residuals of regressions of the real aluminium prices on newsprint prices and Aluminium prices on the Australian Dollar exchange rate are themselves stationary series (the unit root hypothesis can be rejected, although less strongly in the case of the exchange rate). This allows us to hypothesise that both Aluminium prices, Newsprint and the Australian dollar exchange rate may be subject to similar economic influences and shocks.

**Granger Causality Tests**

Granger Causality tests are a method of econometrically assessing the pattern of causation between two or more variables. They do not substitute for a theory of causation, as correlations may be spurious, but can confirm patterns numerically or disprove incorrect theories.

Pair-wise Granger causality over the period of 1957 to 2006 for Zinc, Aluminium, Newsprint, Ferromanganese and the exchange rate is shown in Table A1.7. The null-hypothesis is that the ‘excluded’ variable does *not* Granger cause the dependent variable. Based on the results above, we cannot the reject the hypothesis that zinc prices do not Granger cause aluminium prices but that the aluminium price Granger causes price movements in Zinc. Thus we believe price movements in Aluminium lead price changes in Zinc. In other pairwise comparisons, aluminium leads newsprint and newsprint leads zinc, zinc strongly leads price changes in ferromanganese (as does aluminium). Ferromanganese and newsprint do not exhibit significant Granger causality.

## Table A1.7 Granger Causation Zinc-Aluminium-Newsprint-Australian Dollar 1986 to 2004

Pairwise Granger Causality Tests
Date: 02/15/07 Time: 12:18
Sample: 1957M01 2006M10
Lags: 2

| Null Hypothesis: | Obs | F-Statistic | Probability |
|---|---|---|---|
| ALUMRT does not Granger Cause ZINCRT | 595 | 2.36202 | 0.09512 |
| ZINCRT does not Granger Cause ALUMRT | | 0.20126 | 0.81775 |
| NEWSPRINTRT does not Granger Cause ZINCRT | 216 | 3.46951 | 0.03292 |
| ZINCRT does not Granger Cause NEWSPRINTRT | | 0.33619 | 0.71487 |
| CRUFEMNRT does not Granger Cause ZINCRT | 415 | 0.27369 | 0.76070 |
| ZINCRT does not Granger Cause CRUFEMNRT | | 8.96083 | 0.00016 |
| USDTO1AUD does not Granger Cause ZINCRT | 595 | 2.11296 | 0.12179 |
| ZINCRT does not Granger Cause USDTO1AUD | | 2.05163 | 0.12944 |
| NEWSPRINTRT does not Granger Cause ALUMRT | 216 | 2.49749 | 0.08472 |
| ALUMRT does not Granger Cause NEWSPRINTRT | | 5.52106 | 0.00460 |
| CRUFEMNRT does not Granger Cause ALUMRT | 415 | 0.57723 | 0.56191 |
| ALUMRT does not Granger Cause CRUFEMNRT | | 3.41569 | 0.03379 |
| USDTO1AUD does not Granger Cause ALUMRT | 595 | 5.35922 | 0.00494 |
| ALUMRT does not Granger Cause USDTO1AUD | | 1.59823 | 0.20313 |
| CRUFEMNRT does not Granger Cause NEWSPRINTRT | 216 | 1.47962 | 0.23008 |
| NEWSPRINTRT does not Granger Cause CRUFEMNRT | | 0.00816 | 0.99188 |
| USDTO1AUD does not Granger Cause NEWSPRINTRT | 216 | 0.68884 | 0.50328 |
| NEWSPRINTRT does not Granger Cause USDTO1AUD | | 0.40034 | 0.67060 |
| USDTO1AUD does not Granger Cause CRUFEMNRT | 416 | 7.33126 | 0.00074 |
| CRUFEMNRT does not Granger Cause USDTO1AUD | | 0.82922 | 0.43712 |

For the exchange rate, the US/Aus dollar exchange rate appears to Granger cause the price of Aluminium and the price of ferromanganese, but the relationship between the exchange rate and the remaining commodities is weak.

When examined over the period of Australian dollar float post 1983 the causation pattern of Aluminium leading Zinc strengthens significantly. Somewhat unusually, no individual metal or newsprint appears to Granger cause the Australian dollar exchange rate.

## Econometric Terms for the Business Reader

The analysis of prices utilises several econometric concepts with which the reader may not be familiar, the following guide may therefore be useful:

**Random Walk**
Sometimes called a 'drunkard's walk' a random walk is the formalisation of the idea of taking successive steps in a random direction. Properties such as whether the length of each step is constant or variable and whether there are 1 or 2 dimensions then determine the mathematical behaviour that is expected.

**Unit Root**
A unit root is a way of describing a random walk process. If a series can be described by $y_t = x_t + By_{t-1} + \varepsilon_t$ and *B* is equal to 1 then the process has a unit root which is also called a stochastic trend. In this case a random shock will cause permanent changes to the series. Stochastic trends may make identifications of time trends spurious. If B is less than 1, then a process will converge back to some variable if disturbed (i.e. shocks are non-permanent).

**Cointegration**
Co-integration occurs when a group of variables that have a unit root operate on the same stochastic trend, so that while a shock will affect the variables permanently, the relationship between them still holds.

**Non-Stationary – Stationarity**
Stationarity refers to a process that will converge back to some base value and does not have a unit root. Non-Stationarity refers to a process that has a stochastic trend and does not converge back to a base value.

**Auto-regression**
An autoregressive process is one in which the value of previous variables is important for determining the current value for example $y_t = x_t + By_{t-1} + \varepsilon_t$ where B is not equal to zero (and is less than one). Under such a system, shocks will have transient effects, and the process will attempt to converge to a value determined by *B* and x.

# Chapter Two: The Economic Impacts

## 2.1 The Importance of the MEG industries

The history, culture and economy of Tasmania are all deeply rooted in the mining and mineral processing industries. According to Alexander (2005, p.421-422), the development of Tasmania beyond its agrarian roots is largely explained by the development of a mining industry in the first place and ultimately by a mineral processing sector, a downstreaming processing activity which is dependent upon the transformation of Tasmania's rich ore deposits. This development had many spin offs for the island's economy, not the least of which was the creation of a market for energy, and the development of a hydro based power system. Without the development of both mining and mineral processing industries, Tasmania's wild rivers would never have been harnessed as a power source, and the domestic population would have never gleaned the benefits of such a cheap, environmentally friendly source of energy. The development of the hydro system enabled a series of Tasmanian governments to diversify Tasmania's industrial base by offering cheap power to potential corporate investors and in this way Tasmania's hydro industrial era was born.

The Major Employers Group (MEG) is constituted by industries which avail themselves of Tasmania's clean, green energy source – hydro power. Their use of hydro makes the group collectively and individually an environmentally friendly manufacturing base in comparison with many interstate and international manufacturing concerns based on non-renewal energy resources such as coal which utilise potentially more polluting processes. The MEG industries dominate Tasmania's export base and are regarded by many as a major strength of the Tasmanian economy. To remind sceptics of interstate and international export sales of the MEG industries output accounted for more than 46% of the value of Tasmania's exports in the 12 months to June 2005, while non ferrous metal exports accounted for 38 percent of all Tasmanian export earnings in that year. This export contribution is well ahead of export woodchip and other timber exports, the second most important export commodity group. Although politicians and less well informed commentators continued to laud Tasmania's export performance and its recurring positive trade balances (exports minus imports) our trade performance is quite fragile. To put this net export performance into its proper context, one half of Tasmania's production is exported overseas or interstate and of this more than one half of this export base is contributed by the island's mining and mineral processing industries. Without these, Tasmania's overall living standards would suffer an irreparable decline. The contextual summary about fragility is to be found in the following from historian Heather Felton:

> *"However, diversification and value adding continue to be key issues as overseas exports remain concentrated in a handful of commodities and except for ships and boats all top 10 exports (representing 70 percent of value) are raw materials or food products."*
>
> Felton *(2005, p.126)*

In the preceding Chapter One of this report we emphasised the intensely competitive nature of selected MEG industries. They are almost exclusively price takers and do not appear to possess any substantial monopoly power. The prices they receive are volatile, unpredictable and lead to price surprises. However, these industries remain absolutely critical to the economic welfare of this island. If the MEG industries catch a cold in the chill winds of global recession then the Tasmanian economy is likely to experience a bad case of double pneumonia.

The aim in the remainder of this Chapter is to assess the economic impact on Tasmania of withdrawing a sample of MEG industries from current production. In other words, to contemplate the effects of simultaneously shutting down these industries. For this purpose, the following industry sample was selected: Norske-Skog (timber processing), TEMCO (mineral processing), Nyrstar (mineral processing), Zinifex Rosebery (mining) and RTA (Bell Bay) also a mineral processor. The industry categories shown in brackets are the corresponding industries on the Tasmania input resources output (TIRO) Input/Output model of the Tasmanian economy. The Norske Skog company produces newsprint from its Boyer Mill and TIRO picks up its complete contribution to the Tasmanian economy in the form of direct, indirect and consumption induced effects from the Boyer Mill by applying TIRO's timber processing industry multipliers to the final demand for Norske Skog's output. These concepts are fully described in the following Section 2.2 of this report. The sample also included three smelting (mineral processing) industries, namely TEMCO, Nyrstar and RTA (Bell Bay). When the TIRO model was first developed, the initial researchers deliberately separated mining from mineral processing or smelting which they felt provided the best modelling representation of Tasmanian industry. The multipliers associated with mining are in the range 3.0 to 3.5 and are slightly less for mineral processing (2.5 to 3.0). The current TIRO model preserves this distinction between Mining and Mineral Processing.

In summary our MEG sample consists of five industries: Norske Skog, RTA (Bell Bay), TEMCO, Nyrstar Hobart and Zinifex Rosebery: one timber processing industry; three mineral processors and one mining operation. This sample constitutes a major part of the MEG group.

### 2.2.1 The Scenario underpinning this Study

All studies focussed on determining the effects of major economic events require assumptions and definitions which constitute the scenario underpinning this study. In this study we adopt the fiction that the five MEG industries (MEG 5) shut down their Tasmanian activities over an unspecified period. This reasoning is fictional as the likelihood that all or any of the five for that matter will ever countenance withdrawal is low. To leaven the fictional nature of this scenario, we acknowledge that the MEG 5 or a subset of them will never close down operations at the same point in time. It is important for this reason to select a modelling technique which is independent of time. The input/output model selected for this study is well suited as it is a static (not time dependent) and not a time dependent model. In this study we will be taking a snapshot of the Tasmanian economy and developing a movie of its changing characteristic.

A second preliminary issue concerns aggregation and the presentation of an aggregated impact of all five industries taken together. This means the subtleties of the multiplier analysis which is the driver of the I/O analysis combined herein. What we will have instead is a composite table of economic impacts which simply aggregates the results of 3 separate sets of I/O simulations which answer the question posed and to which we now turn.

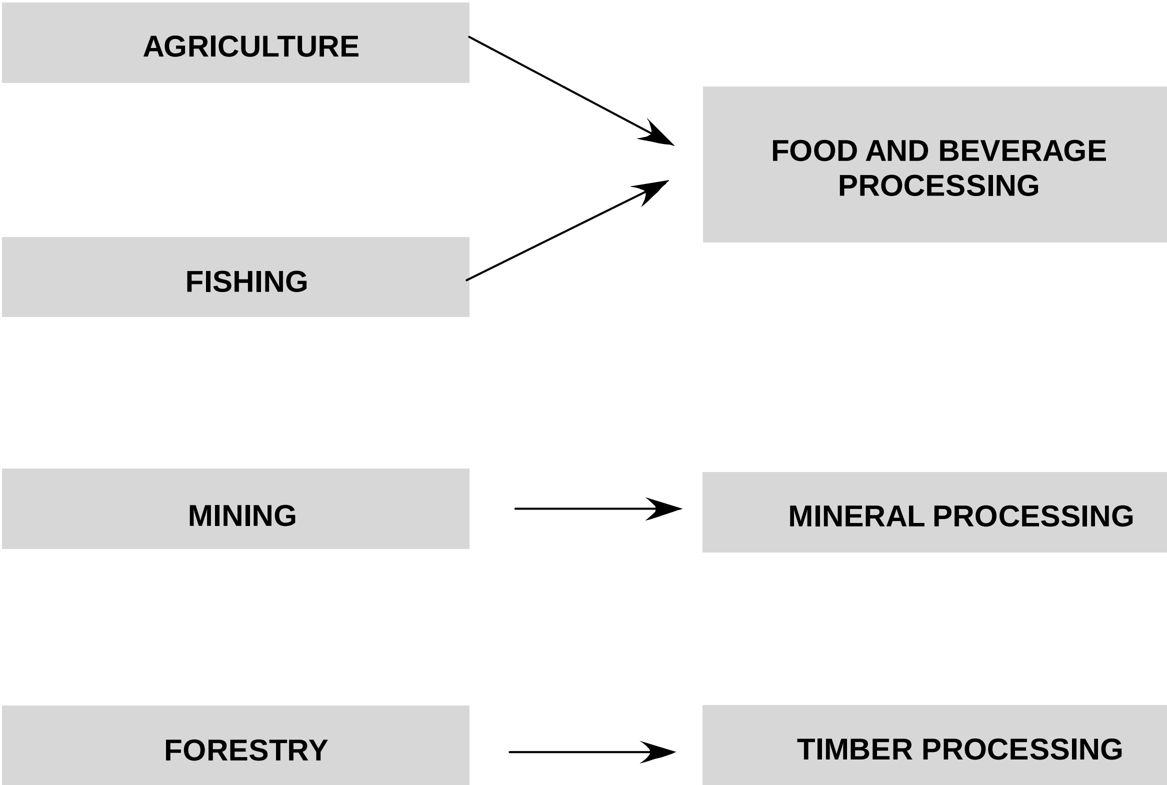
## 2.2 Statewide Economic Impacts of Shutting down the five MEG Industries

### 2.2.2 Methodology

The question of central interest can now be put: What is the total (direct plus indirect + consumption induced) impact of the sampled MEG companies on the Tasmanian economy? In particular what is the MEG 5 contribution to the value of output in all Tasmanian industries? What is the MEG 5 contribution to Statewide employment, to the total wages income of Tasmanian workers and what is its value added contribution to Tasmania's national income, otherwise known as Gross State Product (GSP)?

The approach adopted here is based on the output, employment, wages income and total income (GSP) multipliers contained in the Input/Output model known as the Tasmanian – I/O Resource Model (TIRO). TIRO's history and its derivation are detailed in Appendix B along with a brief summary of I/O modelling. In general terms, TIRO is a static I/O model comprised of 11 linked Tasmanian industry sectors, namely Agriculture, Forestry, Fishing, Mining, Food and Beverage Processing, Mineral Processing, Timber Processing, Other Manufacturing, Construction/Utilities and Transport, Public Services and Private Tertiary Services. This industry classification is based on the ANZIC 2 digit level, although it has been restructured to capture the essential features of linkages between Tasmanian industries. The model also includes a twelfth industry, namely, households to close the model and allow consideration of consumption induced effects as explained presently. The unique linkage structure of the Tasmanian economy is demonstrated graphically in Figure 2-1 and stresses the four key forward linkages contained in a model custom made for the structure of the Tasmanian regional economy and based on a survey of Tasmanian businesses. These 7 industry sectors account for 30 percent of Tasmania's GSP, while the services sector account for 50 percent and the balance is spread between Other Manufacturing, Construction Utilities and Transport.

**Figure 2-1: Forward Linkages in Tas I/O – Resources**




The output of the agricultural sector serves as an input to Food Processing, Mining to Mineral Processing and Forestry to Timber Processing. A final property of the TIRO resource model is its closed nature. This is achieved by including Households as a twelfth industry sector. The output of the Household sector is the wages and salaries paid to it and in return households supply labour to other sectors. The advantage of closure in this way is that the full effects of a final demand change can be measured. An open model is only capable of identifying the direct and indirect effects of an industry and not the consumption induced effects of a change in final demand.

The projection method for calculating contributions is now applied to the TIRO Resource Model. We start with the output vector determined as the product of the matrix of industry output multipliers (B) and the vector of industry final demand (D):

$$X = BD \tag{2.1}$$

The sampled MEG group of industries have operated in Tasmania for many years. To calculate the economic impact of withdrawing the sampled MEG companies we apply the projection method by just taking the estimated value of the MEG's group final output and reduce the final demand vector D in (2.1) above by these estimated final sales and recalculate the output vector as the product of the matrix B (the Leontieff inverse matrix in Appendix B). The result is the revised output vector $X^1$. The impact of withdrawing the MEG group is deemed to be commensurate with the difference $(X – X^1)$.

$$X^1 = BD^1 \quad (2.2)$$

Output in all industry sectors will fall as a consequence and the elements of $X^1$ will be smaller than X. Employment effects are found in identical fashion after initially multiplying the output equations of the model by the Employment/Output ratio. Further wage impact multipliers can also be obtained by first multiplying the output equations (X) of the model by the wage/output ratio. Finally, total income multipliers and the contribution of the MEG sample to State GSP can be gauged once the output equations are multiplied by the ratio: total income/output and the model is run once more to determine these and the contribution of the MEG group to Tasmania's GSP. The mathematical derivation of these multipliers is shown in Appendix B.

## 2.2 Statewide Economic Impacts

The sampled MEG group of companies have the following current outcomes relevant to the calculation of economic impacts associated with these companies current operations.

**Table 2.1 MEG Sample: Trend Value of Final Demand**

| Company | Final demand (Trend value $'mill) | I/O Industry Classification |
|---|---|---|
| Norske-Skog (NS) | 281.956 | Timber Processing |
| TEMCO (T) | 289.865 | Mineral Processing |
| Zinifex Rosebery (ZRO) | 174.734* | Mining |
| Nyrstar (Nyr) | 570.450 | Mineral Processing |
| RTA (Bell Bay) | 486.139 | Mineral Processing |

* Excludes intermediate sales to Nyrstar.

The trend value of final demand is calculated by first computing the 12 months moving average of sales (including intermediate sales) and then deducting the trend value of intermediate sales from this trend value. The results are shown in the second column of Table 2.1. The final demands for the output of NS, T, ZRO, Nyr are $281.956 million; $289.865 million, $174.734 million and $570.450 million respectively. The trend value is preferred because it smooths out the effects of the recent boom in commodity prices and trough in prices experienced in 2001-02.

RTA (Bell Bay) were not able to provide data on revenue and earnings nor about expenditures on transport or energy. Thus to obtain an estimate of the final demand for RTA (Bell Bay) output we applied the industry standard output/employment ratio from the TIRO Input/Output table to RTA (Bell Bay) people expenditures (labour cost) in each of the financial years 1995-2006. This procedure gave us an estimate of total sales for each year and from this estimate, we calculated final demand for RTA (Bell Bay) output in the usual manner by isolating the trend demand after eliminating intermediate sales. The estimated final demand for RTA (Bell Bay) output is $486.139 million annually as shown on Table 2.1. To test the veracity of this procedure, we applied the same procedure to Nyrstar and TEMCO and compared this simulated final demand for these producers against their reported data and found in both cases that the actual numbers deviated from their simulated values by 5 to 10%. The impacts flowing from the shut down of these five MEG industries is calculated by applying the projection method described in Section 2.2.2. The final demands shown on Table 2.1 are assumed to be reduced to zero and Output Gross State Product, Wage Income and Employment effects are determined by applying TIRO's Output, total income (GSP effect), wage income and employment multipliers to the final demands shown on Table 2.1.

**Table 2.2: Output, GSP, Wage income and Employment losses if the sampled MEG firms shut down**

| TIRO Industry | Output $mill | GSP $mill | Wages $mill | Employment eftsu |
|---|---|---|---|---|
| Agriculture | 150.30 | 69.98 | 27.03 | 429 |
| Forestry | 123.67 | 99.86 | 23.64 | 374 |
| Fishing/Processing | 23.56 | -12.40 | 3.12 | 44 |
| Mining/Services to Mining | 279.02 | 146.94 | 25.91 | 376 |
| Food/Beverage | 111.79 | 53.49 | 20.55 | 314 |
| Mineral Processing | 1685.36 | 762.96 | 168.00 | 2147 |
| Timber Processing | 336.99 | 213.17 | 44.62 | 723 |
| Other Manufacturing | 176.43 | 83.20 | 32.42 | 524 |
| Construction, Utilities, Transport | 413.21 | 191.52 | 71.22 | 1060 |
| Public Services | 34.35 | 16.59 | 6.33 | 101 |
| Private Tertiary Services | 302.80 | 152.55 | 56.74 | 943 |
| | **3637.48** | **1802.66** | **479.58** | **7035** |

If these five MEG industries shut down then the value of Tasmanian output across all its industries will fall by $3637 million per annum, 7,035 additional jobs will be lost in these same industries and the wages income generated for Tasmanian workers will decline by $480 million per annum and the State will loose $1,802 million of its current GSP. These losses are significant, so the context in which they are set should be clearly explained.

The output effects involved in foregoing the production of the MEG group leads to a reduction of output in all Tasmanian industries of $3,637.48 million.

The major losers are as we expect the mineral processing sector where output falls by $1685 million while the mining business closure would cost the Tasmanian economy $279 million in lost output annually. Timber processing and forestry also suffer severe output losses ($336 million and $123 million respectively) reflecting the impact of Norske Skog's departure. The Construction, Utilities and Transport sectors lose collectively $413 million of business reflecting the MEG samples' reliance upon hydro power (utilities) and transport. A large part of the "consumption induced" effect of the MEG samples shutdown is evident in the effect of the MEG samples withdrawal on the provision of private tertiary services where the output loss is $302 million annually. In summary, the output of all Tasmanian industries is seriously affected by the MEG withdrawal.

Output effects require the elimination of intermediate sales and purchases so the number which best reflects an industry's contribution to the economy is its value added or total income effect otherwise referred to as the impact on GSP (Gross State Product). From Table 2.2, if the five industries comprising this sample were to shutdown then Tasmania would lose approximately 13 percent of its real income. This represents a catastrophic fall in living standards by any measure and highlights the irrelevance of loose, casual and uninformed commentary from the extreme (not the moderate) industry antagonists who argue that we can dump these basic industries for some ill specified alternative. There are no magic wands to be waved in relation to the radical restructuring of the Tasmanian economy to achieve such an agenda.

The industries most affected by the demise of the MEG five include mineral processing where the loss of value added amounts to $762 million, mining which will contribute some $147 million less annually in GSP; Timber Processing whose GSP contribution will go down by $213 million, private tertiary services where value added falls by $152 million per annum and Construction, Utilities and Transport whose annual contribution to Tasmania's National Income (GSP) falls be $191 million per annum.

The specific effects on household income are reflected in the wage income effects of the MEG sample shutdown. Households stand to lose $480 million in lost wages income with the industry by industry effect similar to the impacts on Output and Gross State Product.

Finally the shutdown of the MEG sampled companies will also create the largest displacement of labour experienced in Tasmania since the great depression. No other single economic shock could lead to the loss of 7,035 jobs and potentially a depression like recession in Tasmania.

The contribution of the MEG 5 sample to a healthy Tasmanian economy is profound. This is well understood in official circles, while it might be argued that the group's contribution to Tasmanian communities is not so well understood. This issue is addressed in the following chapter.

## Chapter Three: The Contribution to Social, Physical, Human Capital and the Environment

### 3.1. Introduction

The selected MEG industries economic contribution to the size and growth of the Tasmanian economy is substantial. In summary, the withdrawal of the MEG 5 is projected to diminish the value added of all Tasmanian industry sectors by 12 percent. This constitutes the core of any debate about the value of the MEG 5 to the Tasmanian community. However, the economic contribution by itself is a necessary but not entirely sufficient representation of the MEG 5 contribution in a climate of changing social attitudes which place far greater emphasis these days on the social outcomes of individual business activity. In Chapter 3 of this report we introduce some of the broader social dimensions by identifying the less well identified community contributions of the MEG 5 to the quality of Tasmanian lifestyles.

There is scepticism among statistical technologists about the fuzzy nature of some of the measures described in the following paragraphs. However, this fuzziness does not destroy the relevance of the social dimensions as governments are forced to respond to political pressures for the achievement of corporate social responsibility, pollution abatement and sound corporate governance. Thus the aim in this section of the report is to assess the MEG 5's socio-economic contribution to Tasmania. The specific characteristics analysed in the following paragraphs include the contribution to the Tasmanian community through networking; their investment in human capital and their contribution to the community through property endowments and research. These topics are discussed in the present Chapter. Environmental factors are separated out as Chapter Four given the topical nature of these. The data on which this chapter of the report is based were provided on the survey questionnaire sent to each of the 5 industries and appended as C.

## 3.2 MEG 5 Contribution to the Stock of Tasmanian Social Capital through Networking

### 3.2.1 The Concept of Social Capital

To confirm the respectability of studies about "social capital" and its measurement, it is appropriate to discuss the concept from the perspective of a long established and conservative institution: the *Australian Bureau of Statistics* which in its Discussion Paper on Social Capital includes the following definition:

> "Social Capital is fast gaining wide interest and use among policy makers, politicians and researchers alike. There is also a strong push from the general community to use social capital as a way to not only describe but also to understand community well-being. Using purely economic terms for such a task is seen as inadequate. This interest is also fuelled by some promising research indicating that social capital may further explain the disparities in health, housing, education, and other facets of social life".
>
> Australian Bureau of Statistics (2000)

This reference to the interests of politicians and policy makers should be enough to convince the business community about the importance of social and community aspects of business activity. Politicians set the regulatory framework and policy makers implement its provisions. The case for observing the triple bottom line therefore strengthens and although several social variables either defy measurement completely or are too fungible as a basis for interpretation, their value hinges on this heightened political awareness driven by community sensitivities about social issues.

Social capital is defined by the organisation of Economic and Cooperative Development in the following terms:

> "Social capital is networks together with shared norms, values and undertakings that facilitate cooperation within or among groups"
>
> OECD (2001,p. 93)

This definition implies (as they all do) that community bonds are based on trust and reciprocity. Winter (2000) captures the spirit of this community togetherness in his definition of human capital as:

> "Social relations of mutual benefit characterised by norms of trust and reciprocity".
>
> Winter (2000, p.V)

Certain key characteristics of Social Capital are outlined by the Productivity Commission (July 2003) in their report on social capital. These are repeated in the following table:

**Key Points**

- *Social capital is an evolving concept. It relates to the social norms, networks and trust that facilitate cooperation with or between groups.*
- *Social capital can generate benefits to society by reducing transaction costs, promoting cooperative behaviour, diffusing knowledge and innovations, and through enhancements to personal well-being and associated spill-overs.*
- *Some aspects of social capital can have adverse effects, such as when strong internal group cohesion is associated with intolerance of others.*
- *Governments already undertake many functions that implicitly aim to support or enhance social capital. However, some government programs and regulations risk inadvertently eroding social capital.*
- *Whereas devising policies to create social capital generally is problematic, governments should at least consider the scope for modifying policies that are found to damage social capital, and ways of harnessing existing social capital to deliver programs more effectively.*
- *At present, there is limited understanding of social capital and how different policies interact with it, and measurement is difficult. Further research, coupled with small scale policy experimentation, may be warranted to provide better knowledge and tools for incorporating social capital considerations in policy analysis where appropriate.*

Productivity Commission (2003, p.viii)

The Productivity Commission's interest in Social Capital is a further reflection of its significance for public policy in Australia. The Commission's report is motivated by the economic consequence evident in some of the Commission's early inquiries into Australian gambling, competition policy and the jobs network.

Common to all definitions of social capital are the notions of social norms, networks, trust and reciprocity. Social norms are those informal societal rules which condition behaviour. For example, younger people surrendering bus seats to elderly passengers, not littering or picking up litter. Further there are the generalised norms of tolerance, honest behaviour and helping the needy. This last point explains the motivation of some 3 million Australian volunteers who provide such assistance free of charge. Social networks are groups of interactive individuals sharing a common attribute. Football supporters, occupational groups, denominational groups or even the local community friends and social groups, regularly sharing a barbeque on Sunday afternoons are examples. One of the key overriding characteristics which bonds such groups is reciprocity which has its root in an earlier religious era: "do unto others as you would have them do unto you". Finally, trust is the level of confidence individuals hold in relation to those with whom they interact. So the definition of social capital really comes down to adherence to social norms, well developed networks and associated levels of trust.

Why are these 3 elements of relevance to firms such as the MEG 5? The answer is that their bottom lines are affected particularly in the long term by developing these attributes, thus recognition of social capital contributes to productivity growth and to long run rather than short profit maximisation. The channels through which benefits pass to business and industry are reduced transactions and information costs, through the knowledge channel which disseminates knowledge and diffuses technology. Transactions and information costs are reduced if the parties to such transactions adhere closely to social norms. This makes for a more certain world, less expensive contractual processes because contract clauses need not be so comprehensive, if the parties exhibit stability in terms of the prevailing, well understood norms.

**Social Networks** reduce transactions cost in more than one way. Information networks involving business, government and labour representatives are important communication channels, as the more developed the network, the lower are the "search costs" involved in procuring information to underpin a business or individual decision. Second *networks* really define/underpin trust within organisations and can reinforce compliance with group norms. In this fashion, well developed networks reduce transactions cost. Finally, *trust* oils the wheels of industry by getting parties with disparate rewards from an organisation communicating to achieve a common goal. How much more productive is the industry which has a high degree of trust between its employers, employees and contractors? The contribution of trust within an organisation to the specification of contracts is a matter examined by Nobel Laureate Robert Solow (1998).

> *"No contract can possibly specify every contingency that may arise between the parties and transactions costs will be lower, defensive behaviour will be diminished and performance will be better if the parties can legitimately expect each other to be reasonable or non-exploitative if one of these uncovered contingencies should pop up."*

In other words contracts are secured through trust.

In general terms, the knowledge channel is the media through which ideas and information passes between and among group members. The general principle applying here is that the more connected is a business group or community, the more efficient (and therefore the less costly) is the dissemination of information. Silicon Valley is often cited as a leading example of an efficient knowledge system.

In the absence of social norms, the way is open for individuals to pursue their self interest and although this is usually regarded as a healthy characteristic, there are circumstances in which the pursuit of self interest coughs up social costs, in particular, where an individual's actions impose external costs upon other people: environmental degradation including pollution is a case in point. The role of cooperative norms in this circumstance is to constrain these external consequences of self interest.

The extent of this externality issue depends on the nature of social capital itself. Sociologists distinguish three types of Social Capital.

- "Bonding" social capital refers to the relationship between members of homogenous groups such as ethnic, religious or socio-economic groups.
- "Bridging" social capital refers to relations between heterogeneous groups and strengthens ties between groups (civil rights movement, ecumenical religious organisations).
- "Linking" social capital refers to individuals and groups in a social strata which is hierarchical and where ties are secured through a power/delegation hierarchy. Putnam (2000, p. 23) indicates that bridging social capital, although generally beneficial is more likely to impose external costs in comparison with the remaining forms.

In summary, the imperative for firms such as Nyrstar to consider the interaction with social capital is driven by two issues: the potential long term benefits for industry which are bestowed by this interaction and creation of awareness among industry managers of the effects of public policies formulated with recognition of social values included.

### 3.2.2 The Measurement of Social Capital

Anyone involved in the business of precise measurement will not be particularly impressed by the variegated nature of the measure of social capital. However an overview of these measures is informative. A useful starting point is the World Values Survey (Inglehart (1999), www.tsr.umich.edu)) which provides national data on beliefs and values. Given the predominance of *trust* in any definition of social capital it is not surprising the question on trust in the world values survey is a leading indicator of the value of social capital. The question put to survey respondents reads as follows:

“Generally speaking, would you say that most people can be trusted, or that you cannot be too careful in dealing with people”. From these responses, the proportion who trust and do not trust is calculated. The Productivity Commission, (2003, p.27) finds that Australia ranks 12th of 29 OECD countries in the 1995-96 survey.

From the same World Values Survey, Social Capital is assessed from the level of “civic co-operation” from responses to the following question: “the following practices can always be justified, never be justified or somewhere in between:

(a) claiming government benefits which you are not entitled to:
(b) avoiding a fare on public transport:
(c) cheating on taxes if you have the chance:
(d) keeping money that you have found:
(e) failing to report damage that you have done accidentally to a parked vehicle:

Australia performed worse on this social indicator coming in 21st of 29 OECD countries with a civic cooperation score of 38%.

To demonstrate the diversity of social capital indicators consider the work of Putnam (2000) for the US as reported in the Productivity Commission (2003, p.28). The following shows the results for no fewer than 14 social capital indicators.

**Putnam’s indicators of social capital for the United States**

Measures of community or organisational life:

- Percentage of individuals who served on a committee of a local organisation in the last year (0.88[a])
- Percentage of individuals who served as an officer of some club or organisation in the last year (0.83)
- Civic and social organisations per 1000 population (0.78)
- Mean number of club meetings attended in the last year (0.78)
- Mean number of group memberships (0.74)

Measures of engagement in public affairs:

- Turnout in presidential elections, 1988, and 1992
- Percentage of individuals who attended public meeting on town or school affairs in last year (0.77)

Measures of community volunteerism:

- Number of non-profit organisation per 1000 population (0.82)

- Mean number of times worked on a community project in last year (0.65)
- Mean number of times did volunteer work last year (0.66)

Measures of social trust:

- Percentage of individuals who agree that 'most people can be trusted' (0.92)
- Percentage of individual who agree that 'most people are honest' (0.84)

a. The figure in brackets indicates the item's coefficient of correlation with the final constructed measure across the individual states of the United States.

Source: Putnam (2000)

Cox (2000) provides a range of Australian measures and notes how Australia's stock of capital is actually depleting as a consequence of falling trade union, churches, scouts, guides and service club membership. TV watching, a comparatively anti-social activity had increased at the expense of informal socialising.

None of these measures of social activity refer directly to business or industries such as the MEG 5. However, there is evidence that once social capital is measured it can be used to determine the impact of social capital on economic performance. Examples include the following:

- Knack and Keefer (1997) find that a 10% increase in the Trust index from the World Value Survey increases the growth rate of GDP by 0.8% over the period 1980 to 1992 and that each 80% rise in civic cooperation increases the growth rate by more than one percent.
- La Porta (1997) finds that a one standard deviation rise in trust is associated with an increase in US growth of 0.3%.
- Knack (2000) finds a statistically significant correlation between the level of trust and the rate of development of 25 OECD nations.
- Helliwell (1996) finds a negative relationship between trust and GDP growth.
- There are quite strong links between the deployment of social and human capital.

The OECD (2001) finds (for Europe) that social capital enhances the probability of job seekers finding jobs. Successful job search clearly hinges on connections in social networks. For Australia, Stone, Gray and Hughes (2003) find those who experience social capital poverty are less likely to find employment.

The purpose of reporting these results is to demonstrate the broad spectrum of measures of social capital. However, none of these represent the interests or affairs of the MEG 5, so a representative set of social capital indicators is required before proceeding further. We confine these to the following: the MEG contribution through networking, human capital, property and research.

### 3.2.3 Measures of Social Capital from an industry MEG 5 perspective

The following Table 3.1 collects and collates the responses of the 5 MEG industries to social capital secured through networking. This includes the involvement of executive staff of each institution in industry bodies such as the TCCI, Tasmanian Minerals Council, Government Agencies, seminars/conferences and these are generally valued on hours spent multiplied by an hourly executive wage rate. Conferences, seminars and sponsorships are valued at cost. Of course, there are many other aspects of social capital, but these defy measurement. Consequently, the MEG 5 contribution to social capital errs on the conservative side.

**Table 3.1: Annual Contribution to Social Capital**

| **Activity** | **Examples** | **Annual Expenditure $ mill** |
|---|---|---|
| Industry Networks | Membership of Industry Bodies | 0.449 |
| Community Networks | Membership of Community Organisations,<br>Community Consultation, | 2.069 |
| Seminars, Conferences Workshops | Industry focussed meetings | 0.373 |
| **Contribution to Social Capital through Networking** | | **2.891** |

The creation of social capital through networks arises from the MEG 5's involvement in industry bodies such as the Tasmanian Chamber of Commerce and Industry (TCCI), MEG and industry specific bodies such as the Forestry Industries Association of Tasmania (FIAT) for Norske Skog, Tasmania North, George Town Chamber of Commerce RTA (Bell Bay). Community networking emanates from participation by senior management in organisations such as Rotary, local government bodies and collaboration with privately owned community groups in particular. About one third of the $2.891 million expended by the MEG 5 in partnerships/memberships is secured in this way. However, each of the 5 MEG companies also invest heavily in community consultation programs. The expenditure on consultation aggregated across all 5 organisations amounts to an annual amount of $1.379 million. Community consultation is an indispensable component of the building of trust in and between industry and the community in which industry operates. Industry seminars/conferences/workshops are an integral part of networking and forming bonds across industry sectors.

## 3.3 Investment in Human Capital

A second aspect of social capital is its close links with the quality of human capital and its development. Trust between management, employees and contractors enhance productivity by producing a well adjusted workforce, so all of those practical mechanisms for improving the lot of workers result in increased trust and greater plant productivity. Putnam et.al. (2000), generally recognised as a leading analyst of the links between social and human capital, identifies the following activities which jointly determine the value of both social and human capital and its development.

- Training and Development
- The provision of educational opportunities within and outside the plant.
- Investment in knowledge workers.

These knowledge workers in particular add to the community's skill reservoir and their presence varies greatly across industries. Forestry, for example, invests heavily in forestry research scientists and silviculture experts while tourism has a much lower requirement for knowledge workers. It is both the quality of jobs as well as the physical number of jobs which counts. The MEG 5 are significant employers of knowledge workers in Tasmania.

These human resources contributions can be valued by attributing salary/wage cost for the time employed in such activities. This task is completed on Table 3.2. The investments made by the MEG 5 in human capital provide the core activity in the interface between the educational institutions in Tasmanian and industry. The overwhelming majority of Tasmanian employers simply do not have the employment numbers necessary to sustain such investment levels in HR Table 3.2 shows these investments for the MEG 5 as a group.

**Table 3.2 The MEG Group's Investments in Human Development**

| | **Training and Development** | **Educational Support** | **Knowledge Workers** | **Total** |
|---|---|---|---|---|
| $million | 3.048 | 1.607 | 13.577 | **18.232** |

The MEG 5 invested $3.048 million in general training and development in 2006. This does not include workers on VET programs, apprentices or support for staff at tertiary institutions. These are included in the $1.607 expended annually by them on the tertiary sector. Knowledge workers are included as part of social capital following Putnam (2000 p.42). Their presence in an organisation is an important element of productivity improvement, a matter little understood in the local media. Tasmania's outstanding demographic issue is the sustained out migration of Tasmanians aged 18 to

39 years. Throughout Tasmania's recent population growth surge this out migration continued albeit at a reduced rate. This flies in the face of Tasmania's urgent need to retain labour skills. The reality is that the 18-39 year old group leave because the range and quality of jobs on offer is not sufficiently diverse and the skilled components of this age group search for more attractive options interstate.

The MEG 5 industries do not employ the thousands they once did and although large employers of 400-600 in number they contribute skilled engineering/scientific jobs which may help retain these scarce skills working in Tasmania. The $13 million contribution of MEG 5 skilled workers is calculated at the wage premium of $15,000 per annum per workers. This is the margin by which the average wage paid to highly skilled workers exceed average household income in Tasmania ($53,000 per annum).

### 3.4 Property Endowments

The MEG 5 contribute to community well being in a further way, namely, by endowing property to sporting organisations and for other services. Nyrstar leases the Bowen Road recreation ground to the Glenorchy Council, Zinifex mine at Rosebery leases a football oval to the West Coast Council. The annual value of these property endowments are determined at actual or implicit rentals (if these are not paid) and summed across all 5 MEG industries. The results are shown as property endowments on Table 3.3.

**Table 3.3 Property Endowments, Heritage Properties, Commercial Accommodation – Annualised Value**

| Item | Value $ mill |
|---|---|
| Property Endowments | 1.196 (annual) |
| Heritage Accommodation | 1.500 (value of heritage buildings) |

The imputed income stream from MEG 5 property leased or gifted to the relevant communities amounts to $1.96 million while the value of heritage buildings at various MEG 5 locations amounts to $1.5 million as standing heritage stock. To impute an annual income stream from these stock values more information is required.

# *CHAPTER 4: PUBLIC GOOD CHARACTERISTICS OF THE MEG 5*

## 4.1 Introduction

The recent emphasis on triple bottom lines: financial/economic, environment and social bring to prominence the public good characteristics associated with major industry. A public good is one which can be accessed by all members of society without access being restricted to others. Further no one can be excluded from enjoying the benefits which flow from its use. Those characteristics of the MEG 5's operations which fit this description are a clear natural environment, a safe working environment and research activities which give rise to outcomes which benefit not only the producer but also consumers. We treat these 3 public goods characteristics in sequence beginning with the natural environment.

## 4.2 Contribution to Cleaning up the natural environment (Pollution Abatement)

The MEG 5 are individually subject to a given environmental standard for the output of "bads" which arise in the process of producing "goods". Air pollution standards apply to Nyrstar, RTA (Bell Bay) and TEMCO while Norske Skog must meet standards for effluent. The question of how standards are set and at what level will remain contentious and the final resolution of this awaits the advance of further environmental policies designed to control the output of pollutants such as the implementation of greenhouse emission targets and a market for these along with the carbon tax regimes for over standard emissions. These innovations are in the offing but it is not possible to predict how the MEG 5 will react to these new policies. However, it is possible to put formally the impressive record of the MEG 5 in meeting relevant standards and to measure the investment of this group of companies in meeting existing standards. Table 4.1 shows the total expenditure (capital and operations) on pollution abatement and on site beautification.

**Table 4.1: Expenditure on Pollution Abatement and Site Beautification**

| | **Pollution Abatement** | **Site Beautification** | **Total** |
|---|---|---|---|
| $ mill | $29.439 | 6.500 | 39.939 |
| **Environmental Record 2004 -2006** | **Reportable** | **Incidents** | |
| | RTA (Bell Bay) | 4 in 2006<br>0 in 2004, 2005 | |
| | Norske Skog | 0 since 2004 | |
| | Nyrstar Hobart | 48 in 2003<br>40 in 2004<br>11 in 2005<br>7 in 2006 | |
| | Zinifex (Rosebery) | Nil | |
| | TEMCO | Nil | |

The MEG 5 expended $29.439 million on pollution control over the period 2004-2007. This sum includes both expenditures of a capital nature and those incurred on an operations basis. A further $6.5 million was expended on site beautification and restoration by the MEG 5 collectively. The benefits of these expenditures will be reflected in an improved natural environment over many years, although short term benefits are already evident. In fact, TEMCO, Norske Skog and the Rosebery mine reported no incidents over the period 2004-207. RTA (Bell Bay) returned a clean sheet in 2003, 04, 05 and 07 to date and had only 4 reportable incidents in 2006. Nyrstar Hobart reduced the number of reportable incidents from 48 in 2003, to only 7 in 2004/05, a reduction of 79 percent.

The MEG 5 collectively does satisfy the requirements of Tasmania Together standard (8) goal (24) stated as follows:

*"To minimize material consumption and waste generation"*

The targets will remain a moving feast although the ideal of zero waste targets is unlikely to be met given current technological states.

## 4.3 The Safety Record

A further public good characteristic of modern industrial economies is to develop and maintain a safe and secure working environment. The benefits bestowed by a safe working environment provide external benefits for other industries and the community through their effect on productivity. The Productivity Commission (2003, pp. 16-19) cites the "health" components of social capital as a major source of increases in total factor productivity so evident in Australia's recent economic history.

A standard measure of industry's safety record is the number of days lost through injury and illness. The MEG 5's record on this criterion is recorded on Table 4.2.

**Table 4.2 Number of days lost to illness and injury and cost savings: 2004-2006**

| Reduction in Days Lost to Illness/Injury | Reduction in Labour Costs from improvements |
|---|---|
| 8,585 | $2,403,800 |

The annual reduction in days lost to illness or injury amount to 8,585 and the estimated savings of the MEG 5 on labour costs is $4.404 million. The reduction in labour costs is a private benefit to shareholders and management of the MEG 5, however, the public benefit is also derived from a more productive workforce.

## 4.4 Research

The MEG 5's annualized investment in research activity amounts to $7.015 million in 2006 approximately one half of the University of Tasmania's research grant income and accounts for 15 percent of all R & D expenditure occurring in Tasmania. The benefits of successful research programs are widespread. Although the research of the MEG 5 is directed towards company requirements, it will have a substantial public spin off. Tasmania possesses so few researchers and research staff that the loss of the MEG 5's contribution promises to turn Tasmania into a third world country, in research terms.

# APPENDIX B: Input-Output Modelling

**Principles of I/O Models**

The principles of input-output models are described briefly. The essential feature is that the output of any industry is not entirely sold on a market for the industry's product; some of it will be used by industries associated in the chain of production as an input for production; an example is the output of the Sheet Metal industry which will be in large part purchased by motor vehicle and white goods manufacturers as input to the production of motor vehicles and refrigerators. More relevant local examples are the output of the agricultural industries, which provide inputs for the production of food and beverages, dairy production supports the manufacture of confectionary and dairy products; timber harvested by forest companies is sold to timber processors while mining output is an input to the mineral processing industries. So an essential feature of an I/O table is its backward and forward linkage structure, which defines its set of inter-industry relationships. The development of an I/O model such as the Tasmanian I/O resources model applied in this analysis is based on a transactions table which has the following structure.

Each row shows the distribution of one industry output to other industries and to final demand while each column records the industry in question's acquisition of inputs from other industries comprising an economy. These are referred to as "intermediate purchases", to distinguish them from final purchases/sales.

The table contains 4 Quadrants. The processing sector is shown as Quadrant 1 and records the flow of goods and services between individual industries during a year. The second quadrant (II) records the consumption expenditures of final buyers and the other industry sectors from which they are made. In relation to this for the present study it is noted that exports overseas and exports interstate both form part of final demand, so the output of the MEG group of industries which is sold almost entirely to foreign or interstate buyers is part of final demand for the output of the mineral processing sector and it is the loss of these final demand sales which will impact on Tasmania wide output, total income, wages and employment.

## Figure 1: Quadrants of the Transactions Table

| | | PROCESSING SECTOR | | | | | | FINAL DEMAND | | | | | | TOTAL OUTPUT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OUTPUT TO → INPUT FROM ↓ | Industry 1 | Industry 2 | | Industry j | | Industry n | Consumption | Public Authority Expenditure | Domestic capital Formation | Gross Inventory Accumulation | Exports Interstate | Exports Overseas | |
| | | **Quadrant I** | | | | | | **Quadrant II** | | | | | | |
| PROCESSING SECTOR | Industry 1 | | | | | | | | | | | | | $X_1$ |
| | Industry 2 | | | | | | | | | | | | | $X_2$ |
| | | | | | | | | | | | | | | |
| | Industry i | | | | | | | | | | | | | $X_i$ |
| | | | | | | | | | | | | | | |
| | Industry n | | | | | | | | | | | | | $X_{-n}$ |
| | | | | | | | | | | | | | | |
| | | **Quadrant III** | | | | | | **Quadrant IV** | | | | | | |
| PAYMENTS SECTOR | Wages | | | | | | | | | | | | | |
| | Gross Operating Surplus | | | | | | | | | | | | | |
| | Depreciation | | | | | | | | | | | | | |
| | Payments to Public Authorities | | | | | | | | | | | | | |
| | Imports Interstate | | | | | | | | | | | | | |
| | Imports Overseas | | | | | | | | | | | | | |
| | TOTAL PAYMENTS | $X_1$ | $X_2$ | | $X_j$ | | $X_n$ | | | | | | | |

A particular feature of Quadrant II is the presence of capital items which are included as part of the total expenditure of the individual industries, however, these capital goods are not used up for production in the current period and so they are shown for the production sector only. The model applied to the MEG data is a static one, although it could be made time dependent by making current output a function of last period's stock of capital goods or a similar functional form for investment.

Quadrant III records payments for the use of primary inputs in particular to labour (wages), to corporations as profit (Gross Operating Surplus), to governments in various tiers as indirect taxes and charges and on importers. The value added by each industry to total Tasmanian income, Gross State Product (GSP) measured at factor (input) cost is the combination of some of these payments as follows:

$$Value\ Added_i = WSS_i + GOS_i + Indirect\ taxes_i - subsidies_i$$

So the value added by industry i is the sum of wages, salaries and supplements ($WSS_i$) paid to labour, the gross operating surplus of $industry_i$ ($GOS_i$) plus indirect taxes and charges net of subsidies paid by government to $industry_i$. The sum of all the value added by the i industries constituting the economy is the value of Tasmania's "national income", namely, its Gross State Product (GSP). One of the tasks addressed to the I/O model is to determine how much of the current GSP is lost if the final demand for Ta Ann's output is driven to zero because the project does not proceed.

The fourth quadrant (IV) records the value of primary inputs (capital, labour) passing into final use. This includes imports of consumer and capital goods and direct employment of labour.

**The Math of I/O Modelling**

The transaction table may be presented in the following matrix form where $X_{ij}$ is the amount of industry j's output purchased by industry i as an input and $D_i$ is the final demand for industry i's output.

The transaction table above is defined by dividing the elements of the matrix above by the current value of industry i's output. By this definition:

$$a_{ij} = \frac{x_{ij}}{X_j} \qquad (1)$$

These $a_{ij}$ are the technical coefficients of production and they represent the amount of industry i's output required to produce a unit of output in industry j.

From (1) we can write:

$$x_{ij} = a_{ij} X_j \qquad (2)$$

and the output for industry i is the sum of intermediate sales and purchases plus the final demand for i's output ($D_i$) as follows:

$$X = AX + D \qquad (3)$$

Where X is a vector of industry outputs, D is a vector of final demands and A is an $i_{xj}$ matrix of technical coefficients.

The expression (3) can be solved for X as a function of D:

$$X - AX = D \qquad (4)$$

$$X(1-A) = D \qquad (5)$$

$$X = (1-A)^{-1} D \qquad (6)$$

$$X = BD \qquad (7)$$

The solution vector represents the output of industries as some multiple of final demand (D) the multiple is the matrix $(I\text{-}A)^{-1}$=B. This is known as the Leontieff inverse after its creator. Now B is structured in the following manner:

$$B = \begin{bmatrix} b_{11} & b_{12} \ldots \ldots b_{ij} \ldots \ldots b_{1n} \\ \vdots & \vdots \\ b_{21} & b_{22} \ldots \ldots b_{2j} \ldots \ldots b_{2n} \\ \vdots & \vdots \\ b_{i1} & b_{i2} \ldots \ldots b_{ij} \ldots \ldots b_{in} \\ \vdots & \vdots \\ b_{n1} & b_{n2} \ldots \ldots b_{nj} \ldots \ldots b_{un} \end{bmatrix} \qquad (8)$$

This is referred to as the *table of interdependence co-efficients* and measures the direct, induced and indirect effects of a change in final demand for one of the industry outputs. *The columns of this interdependence co-efficient table are the output multipliers.*

What do I/O output multipliers tell us? I/O output multipliers measure the changes in all industry outputs generated by a change in the final demand for any one output. For example, if the demand for agricultural output in Tasmania increased by 10 percent, then I/O output multipliers measure the impact on all industry output including agriculture.

Employment multipliers describe the impact of a change in the final demand for a specific industry's output on employment in the same and all other industries. These I/O employment multipliers are derived from employment equations, which are derived in turn by simply multiplying the output equations for each industry by the employment ($E_i$)/Output ($X_1$) ratio for the industry in question. So the employment equation for industry 1 is found by multiplying (1) though by $E_i/X_1$. Then I/O employment multipliers are found in the same way by inverting the set of employment equations solving for employment in industry i.

Wage multipliers are found in an identical fashion, but on this occasion wage equations are employed to derive these. The wage multiplier measures the change in all industry wage incomes flowing from a change in any of the final demands.

GSP multipliers measure the contribution of a final demand change to each industry's value added or its individual contribution to Gross State Product (GSP). GSP multipliers are derived from total income equations which are output equations converted to total income relationships by applying value added/output ratios to each industry's outputs.

All four sets of multipliers are applied to the task of identifying employment, GSP, wage and output effects of the Ta Ann project not proceeding.

Here, a distinction should be made between Type I and Type II multipliers. Type I income or output multipliers are the ratio of the direct plus indirect income or output change of demand to the direct income change resulting from a dollar increase in final demand for any given industry.

Type II multipliers are those derived mathematically above and can be read off the column of the B matrix in (7). In either case, type I or II, the I/O model is closed with respect to households which is the case here.

The practicality of I/O models depends on certain properties and assumptions. First, a workable I/O model will be mathematically stable which happens if the following holds:
The table of technical coefficients must have at least one column which sums to a number less than one. No column in the table can exceed one in the aggregate (no industry can pay more for its inputs than it receives from the sale of its output).

The following assumptions underpin all practical I/O models:

- a single production function exists for all firms in an industry.
- this production function must be linear and be homogeneous of degree I (Constant Returns to scale applies).
- there is no substitutability between factions of production (labour and capital).

**History of Tasmanian – I/O Resources**

The I/O model applied to this study is now known as *Tasmanian I/O: Resources (TIRO).*

The first transactions table for Tasmanian I/O: Resources was developed in 1990 from a survey conducted by honours students in the School of Economics with funds provided by the School. The original model was designed to capture the resource-based nature of the Tasmanian economy, so a deliberate decision was taken to select 11 industry classifications which reflected these characteristics. The 11 industries established on the first table were: Agriculture, Forestry, Fishing, Mining, Food and Beverage, Mineral Processing, Timber Processing, Other Manufacturing, Construction and Utilities, Public Services and Private Tertiary Services. A household "industry" was added to close the model.

The model was rebuilt in 1995 from a further survey funded by Unitas Consulting and the Tasmanian Farmers and Graziers Association (TFGA) who were interested in the agricultural based nature of the first model.

The model was recast in Felmingham (2000) when it was clear that technical changes occurring in Forestry had substantially reduced the employment/output ratio in that industry and the 1994 basis was modified accordingly.

A further modification occurs in Felmingham and Mansfield (2001) when a tourism industry sector was identified by separating tourism expenditures (Port Arthur) from Private Tertiary Services and developing a set of Tourism multipliers. The results are that 2 versions of this I/O table are available:

- Tasmanian I/O Resources based on 11 industries plus the household sector to close the model. The 11 industries are those identified above: Agriculture, Forestry, Fishing, Mining, Food and Beverage Processing, Mineral Processing, Timber Processing, Other Manufacturing, Construction Utilities and Transport, Public Services, Private Tertiary.
- Tasmanian I/O Tourism: Based on the 11 industries above with the addition of Tourism services and is also a closed model with respect to Households.

The Tasmanian I/O Resources model is the one preferred for this study.

In recent years refinements of Input/Output (I/O) modelling have been developed. These are labelled Computable General Equilibrium Models (CEG). These transaction based tables add features which are not readily available in I/O modelling. The following list of advantages applies:

- I/O models require regular updating for price changes (inflation). CGE models do allow for these price effects.
- I/O models assume that impacts can be met with an unlimited flow of additional unused resources. CGE models include resource constraints which slow down the response of the economy to shocks.
- CGE models allow net indirect effects to be valued but I/O models do not.

These three advantages taken together mean that I/O models have the tendency to overstate economic impacts by ignoring the negative effects of a shock and focussing only on the positive outcomes.

It is appropriate also to indicate the advantages of I/O models:

- I/O models are easier to work with industries and can be disaggregated more readily to capture particularly local impacts.
- The cost of rising I/O models is less. Presently TIRO is charged out at $3,500 for each replication. Use of one of the national economy models will cost 5 to 15 times more.

The TIRO model has been used on more than 20 occasions to study local economic impacts and on 5 occasions simultaneously. In each of these 5 instances the TIRO I/O model provided quite conservative results in the sense that the output, employment and value added effects in comparable cases were less in the case of the TIRO model, so the issue of overstatement was not evident in these cases. This argument backs up the conclusion of Dwyer, Forsyth and Spurr (2006), who conclude as follows:

> *"…I/O models will overestimate the size of the economic impact. However, these overestimations are not likely to be too large at this level of analysis and the relative ease of analysis means that I/O techniques may be appropriate to assess local impacts", p.61.*

The relevance of I/O modelling is greatest in the smaller economies such as Tasmania because the smaller regions have little impact nationally. Tasmania is a small economy in this context.

# APPENDIX C

## 1. ENVIRONMENT SAFETY & HEALTH

| ACTIVITY | DESCRIPTION | BENEFIT MEASURE |
|---|---|---|
| Pollution Abatement | Reduction of emissions or record of achievement in meeting standards | (i) $..................... Expenditure on environmental control<br>(ii) ……………… Number of reportable incidents |
| Contributions to productivity through health | Health Safety Record Improvement | Reduction in days lost for accident/illness<br>$……………….. expenditure |
| Other environmental improvements<br>(There are probably several site specific initiatives) | Example: Nyrstar beautification expenditure | $......................... expenditure |

## 2. COMMUNITY SUPPORT AND INTERACTION

| ACTIVITY | DESCRIPTION | BENEFIT MEASURE |
|---|---|---|
| Senior Management involvement in Industry bodies | - Attendance at MEG<br>- Contribution to MEG<br>- Membership of TCCI | $......................<br>(days per month x salary)<br>$………………<br>(membership)<br>$………………<br>(days per month x salary per diem) |
| Senior Management involvement in Community Organisations | - Service Clubs (Rotary) | $………………<br>(days per month x salary per diem) |
| Staff and Senior Management at conferences | | $………………<br>(days per month x salary per diem) |
| Community Consultation | | $………………<br>(Cost of Program) |

## 3. IMPROVEMENTS IN HUMAN CAPITAL (INVESTMENT IN HR)

| ACTIVITY | DESCRIPTION | BENEFIT MEASURE |
|---|---|---|
| Meeting the Costs of Staff in University and TAFE training | - Degree Training<br><br>- Diploma, AD Training | $.....................<br>Contribution<br>$.....................<br>Contribution |
| In-House Staff Training | Examples: Nyrstar Unlimited program Smelters Annual Site Leadership Program | $………………..<br>Cost of programs |
| Knowledge Workers | Those with tertiary (Uni and TAFE training) | $………………..<br>Average people cost of tertiary workers minus $53,000 x number of workers |
| VET Workers and Apprentices | Proportion of workers in training and apprenticeships | $………………..<br>Estimated cost of apprenticeship and VET employment |
| General Staff Training and Development | | $………………..<br>Estimated cost of programs |
| Scholarships | Supporting Uni and TAFE students channelled through your institution. | $………………..<br>Cost of Scholarships |
| Tours/Education for School | For example: Nyrstar | $………………..<br>Cost of Program |
| Research and Development | | $………………..<br>Costs of research staff (annual)<br>………………..<br>Number of Researchers |

## 4. Property Endowments

| ACTIVITY | DESCRIPTION | BENEFIT MEASURE |
|---|---|---|
| Lease/Gift of sports facilities | Example: Nyrstar<br>Lease of Bowen road Recreation Ground to Glenorchy Council | $.....................<br>Implicit annual rental value |
| Heritage Values Properties | Example: Nyrstar<br>Land allocation for rare flora | Leave this to consultant |
| Commercial Accommodation | Example: Nyrstar houses<br>Moonah Dental Clinic | $.........................<br>Implicit Rent |